MARKET FORECAST

U.S. Client/Server Software Market Analysis, 1993-1998

Client/Server Markets and Applications Program

U.S. Client/Server Software Market Analysis

1993-1998

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17 Hill Street
London W1X 7FB
England
Tel. +44 (0) 71 493-9335
Fax +44 (0) 71 629-0179

New York
400 Frank W. Burr Blvd.
Teaneck, NJ 07666
U.S.A.
Tel. 1 (201) 801-0050
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Paris
24, avenue du Recteur
Poincaré
75016 Paris
France
Tel. +33 (1) 46 47 65 65
Fax +33 (1) 46 47 69 50

San Francisco
1881 Landings Drive
Mountain View
CA 94043-0848
U.S.A.
Tel. 1 (415) 961-3300
Fax 1 (415) 961-3966

Tokyo
Saida Building, 4-6,
Kanda Sakuma-cho
Chiyoda-ku, Tokyo 101
Japan
Tel. +81 3 3864-0531
Fax +81 3 3864-4114

Washington, D.C.
1953 Gallows Road
Suite 560
Vienna, VA 22182
U.S.A.
Tel. 1 (703) 847-6870
Fax 1 (703) 847-6872

Abstract

The explosive growth in client/server computing is fueled by the need to make organizations faster moving and more flexible. Data processing is already starting to be revolutionized by object-oriented programming. Over the next five years, object-oriented programming will continue to revolutionize client/server computing. It will enable more complex systems to be designed, change the way in which software is marketed and offer new opportunities for developers and integrators.

This report analyzes trends in client/server computing, gives insight into the market from INPUT's database of more than 2,000 users and provides five-year market forecasts for software sales in the U.S.

Number of pages: 104

Number of exhibits: 44

**Client/Server Markets and
Applications Program**

*U.S. Client/Server Software Market
Analysis, 1993-1998*

Table of Contents

Exhibits

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I

Introduction

This report analyzes market and technology trends for client/server (C/S) systems. A survey of more than 2,000 users provides insights into the market. It provides U.S. C/S software market forecasts from 1993 to 1998 as part of INPUT's Client/Server Markets and Applications Program.

A
Purpose of the Report

This report provides insights into the C/S market for:

- Corporate strategists

- Purchasers of C/S systems

- Vendors of C/S components and systems

- Investors in C/S technology

The forecasts and charts are intended for readers to develop market strategies, business plans and financial projections. They are also useful for presentations and sales support.

The report answers the questions:

- What is C/S computing and how does it relate to other architectures?

- What business forces are driving the C/S market?

- What concerns are raised by system purchasers and users?

- What issues are raised by vendors?

- How will C/S systems evolve over the next five years?

- What are the main application trends in C/S computing?

- What are the main technical trends?

- How will the computing platform change?

- How does C/S implementation vary by industry?

- What are the budget growth rates reported by users for different classes of application?

- How are systems and applications software sales likely to grow in the U.S.?

- What are the opportunities and risks presented by C/S computing?

B
Scope of the Report

This report covers global C/S technology trends and forecasts the U.S. C/S software market. The C/S software market is defined as:

- Software that is sold for use in a C/S system

- Software that is used to build C/S systems

The applications software market forecasts cover cross-industry and vertical market applications. Systems control, operations management and applications development tools are the segments covered in the systems software market forecasts.

C/S system budgets and their growth rates are analyzed. Not included in this report are hardware forecasts nor detailed vendor and product information.

C
Methodology

1. Primary Research

Throughout 1993, INPUT telephone surveyed more than 2,000 user organizations. Users were asked where they would be developing new or significantly modifying applications in the 1994-1995 timeframe and also if they were migrating to C/S. The user survey, together with vendor literature and INPUT forecasts,

provides the basis for trend analysis. In addition, interviews with key vendors provided additional insights.

2. Secondary Research

Trade publications and on-line information networks provided additional information for this report.

EXHIBIT I-1

Survey Respondents by Industry

Industry	Number of Respondents
Discrete Manufacturing	285
Process Manufacturing	236
Banking	223
Utilities	211
Business Services	150
Health Services	149
Retail Trade	133
Wholesale Trade	127
Telecommunications	114
Insurance	106
Transportation	102
Education	93
State & Local Government	89
Misc. Industries	59

Number of Respondents
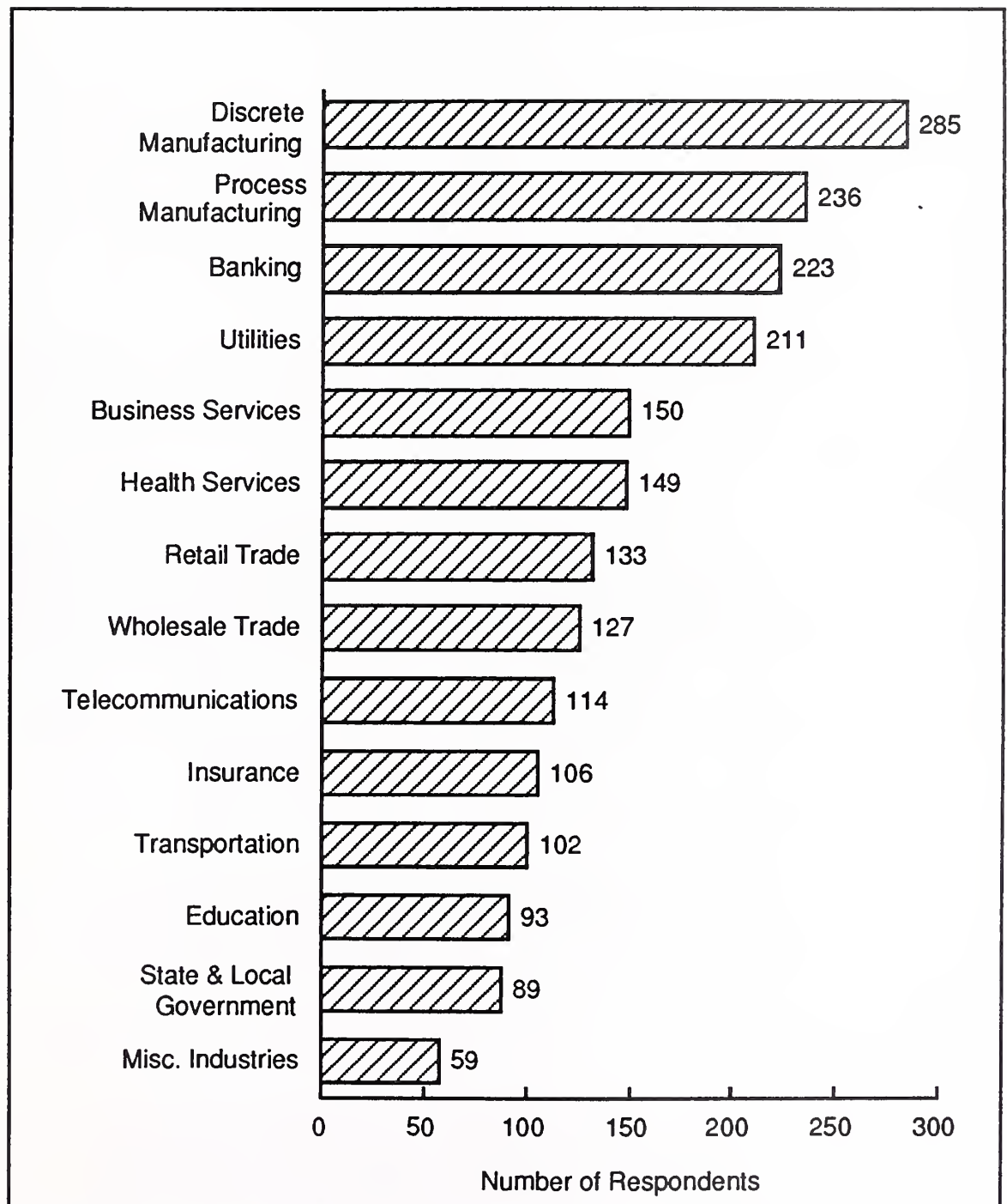
2,274 Respondents   *Source: INPUT User Survey 1993*

3. Forecasting Methodology

INPUT creates annual forecasts in its Market Analysis Program based on vendor revenues, government data and user surveys. These forecasts are validated with industry data and analysts' judgments. Market forecasts are adjusted for distribution channel to produce the size of the U.S. market in user dollars. Forecasts are adjusted into current dollars. For example 1997 forecasts are in 1997 dollars adjusted for inflation.

4. User Survey Demographics

Two thousand, two hundred and seventy-four (2,274) respondents identified almost 3,000 applications modified or developed in the 1994-1995 timeframe. The majority represent user departments, such as accounting, production and human resources and are typically middle managers. The respondents also represent IS organizations.

Exhibit I-1 shows the breakdown of survey respondents by industry. Exhibit I-2 shows distribution of respondents' company size by annual revenues.

EXHIBIT I-2

Respondents Interviewed by Company Size

Revenues ($ Millions)	Number of Respondents	Percent of Respondents
≤ 99	223	10
100–449	913	42
500–999	329	15
1,000–4,999	462	21
5,000+	136	6
Not Available	211	5
Total	2,274	100

D
Report Structure

The report is structured as follows:

- Chapter II provides an executive overview

- Chapter III provides background

- Chapter IV discusses key issues and concerns

- Chapter V provides an analysis of trends

- Chapter VI compares C/S implementation across industries

- Chapter VII provides market forecasts

- Chapter VIII analyzes opportunities and risks

- Appendix A provides definitions

- Appendix B lists vendors mentioned in the report

- Appendix C contains the survey questionnaire

- Appendix D gives forecast details

E
Related Reports

INPUT's Market Analysis Program provides comprehensive forecasts and industry trends.

The following reports provide market forecasts:

- *U.S. Systems Software Market, 1993-1998*
- *U.S. Applications Solutions Market, 1993-1998*
- *U.S. Forecast Compendium, 1993-1998*

INPUT also publishes market analysis reports that cover services:

- *U.S. Professional Services Market, 1993-1998*
- *U.S. System Integration Market, 1993-1998*
- *U.S. Outsourcing Market, 1993-1998*

In the C/S Markets and Analysis Program the following reports provide more details on C/S trends in vertical markets:

- *Client/Server Applications and Trends—Process Manufacturing*

- *Client/Server Applications and Trends—Discrete Manufacturing*

- *Client/Server Applications and Trends—Banking*

- *Client/Server Applications and Trends—Insurance*

- *Client/Server Applications and Trends—Health Services*

- *Client/Server Applications and Trends—Telecommunications*

- *Client/Server Applications and Trends—Utilities*

- *Client/Server Applications and Trends—State & Local Government*

- *Client/Server Applications and Trends—Retail Trade*

- *Client/Server Applications and Trends—Vertical Market Comparison*

INPUT provides detailed profiles on vendors in the Vendor Analysis Program as well as the Client/Server Program. Also, the European market for information services is covered in a series of reports and research bulletins.

II
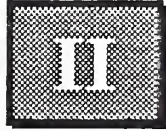
Executive Overview

This section provides an overview of the report, giving a brief background on C/S technology, issues, trends, a market forecast, summary statistics and recommendations.

A
Background

Client/server (C/S) is an architecture that networks personal computers (PCs) or workstations to servers. Companies adopt C/S technology because they want to outsource a function, grow, downsize, connect to another organization or innovate. Besides being used for data processing C/S architectures are useful for scientific computing, engineering, network management, geographic information systems, image processing, real-time systems and document workflow.

The technology has moved from niche applications into mission-critical data processing. C/S widens the gap between technology innovators and laggards. By adopting C/S technology, companies like Walmart, US Sprint and Lotus Development Corporation can reduce inventory costs, provide better customer service and enhance employee productivity.

B
Issues

The main issues in implementing a C/S application are:

- Networking–Are software interface standards supported and is it easy to maintain?

- Security–Is a C/S system as secure as a mainframe?

- Infrastructure–Do networks, PCs and servers need upgrading to support C/S software?

- Performance–Are workstations as fast as dumb terminals?

- Reliability–Does the system as a whole perform reliably and can it be tested?

- Scalability–Will the solution for a small work group be able to grow and meet the needs of the enterprise?

A greater challenge than training programmers, system designers and administrators, is to ensure users get the benefits from a C/S system. This raises the following issues:

- Training–How are users educated and how can reluctant users be encouraged to use systems?

- User interfaces–Are they simple and intuitive?

- Interdepartmental communication–Can MIS and users communicate effectively? Are all the departments that need to use a system involved in the design?

- Information overload–How can a C/S information system be designed to provide precise information required at any instant in time?

System designs must be flexible to support rapidly changing business conditions, custom production and product innovation. In implementing C/S systems, organizations face several challenges:

- Cultural disruption–Who controls information, where will authority reside?

- Remote locations–Can telecommuters, mobile professionals and branch offices have system access with high-speed networking?

- Business rules–Which ones are included in a new system?

- Economic considerations–Cost, pricing, effect on sales and business performance

Large organizations may implement C/S systems because they want to downsize and small ones because they want to grow and control their processes. Efficiency is the critical element driving C/S system implementation in large and small organizations.

The main issues in selling a C/S system are:

- Product engineering—time to market, system complexity, platform selection

- Marketing—channel management, sales and marketing costs, alliance management

Choice of appropriate partners and development tools are critical factors for vendor success.

C

Trends

Client/server systems will evolve from supporting one or two databases, to integrating multiple databases across corporate boundaries. Client workstations and PCs will display more graphics, buttons and dynamic models. Current client/server interfaces that show multiple forms and windows, will be simplifies to automatically display precise information. Agents will carry messages between databases and routine transactions will be automated. Object-oriented software, already used extensively in C/S systems, will become more sophisticated. Programmers will be able to build complex applications much faster. Objects and software components will be managed more effectively using data repositories and encyclopedias.

Object technology will:

- Create a market for component software

- Simplify networking

- Expedite applications development

C/S computing is predominantly associated with databases. However, the next five years will see other technologies integrated into mainstream data processing. Desktop office software suites, like Microsoft Office and Lotus SmartSuite, will be tightly integrated with enterprise messaging and database systems.

Document images, word-processor files and compound multimedia documents will be integrated with databases. Desktop videoconferencing and integration of C/S systems with telephony will also be areas of explosive growth in the next five years. Geographic information systems will move from application niches into major decision support systems.

Workstations will support multiple operating systems. For example, IBM will offer Workplace OS with OS/2, Windows, Apple Macintosh and AIX (IBM's version of UNIX). The role of the operating system on the client workstation will change to become more like that of a software programming language with libraries. It will provide a programming framework that supports a subset of applications. The operating system kernel will provide support for modular file systems along with print and communications support. It will provide standard modules for C/S computing. Windows NT offers a scalable solution to migrate networked PC applications into the enterprise.

Higher-performance C/S development tools from companies like UniFace, Dynasty and Forté will support mission-critical applications. Powersoft's bold move into the retail channel, with its user programming product PowerMaker, brings C/S programming to a cottage industry of independent consultants. This will increase the penetration of C/S systems in small businesses. Acquisitions are rampant with Sybase acquiring Micro Decisionware for its database gateway products, Powersoft obtaining Watcom for its database and tools and Compuware garnering UniFace for its application development environment.

Database companies are expected to become more vertically integrated, offering a complete range of products from systems design to systems operation. Indeed, with nCube (a massively-parallel processor server vendor), Oracle is going one step further and integrating their database with hardware to create a database server. In the past, dedicated database machines have failed to gain widespread market acceptance so it remains to be seen whether nCube will be successful. The proposed merger of ASK into Computer Associates emphasizes vertical integration from systems software to applications, via databases.

Trends are summarized in Exhibit II-1.

EXHIBIT II-1

Summary of C/S Trends

- C/S systems will evolve into networks of databases connected by messaging.

- Agents, objects, interoperable systems will redefine programming.

- Emerging applications will be integrated with databases— document management, messaging, telephony, geographic information systems, multimedia, videoconferencing.

- Workstations will support multiple operating systems which will become programming platforms. Windows NT will provide a scalable upgrade path.

- Higher performance C/S tools from companies like Forté and Dynasty.

- Database companies will become more vertically integrated offering CASE, GUI building and operations management tools.

D
Market Forecast

The market for C/S software is expected to grow at a CAGR of 29% from $14.3 billion in 1993 to $50.6 billion in 1998 as shown in Exhibit II-2.

EXHIBIT II-2

C/S Software Market Forecast
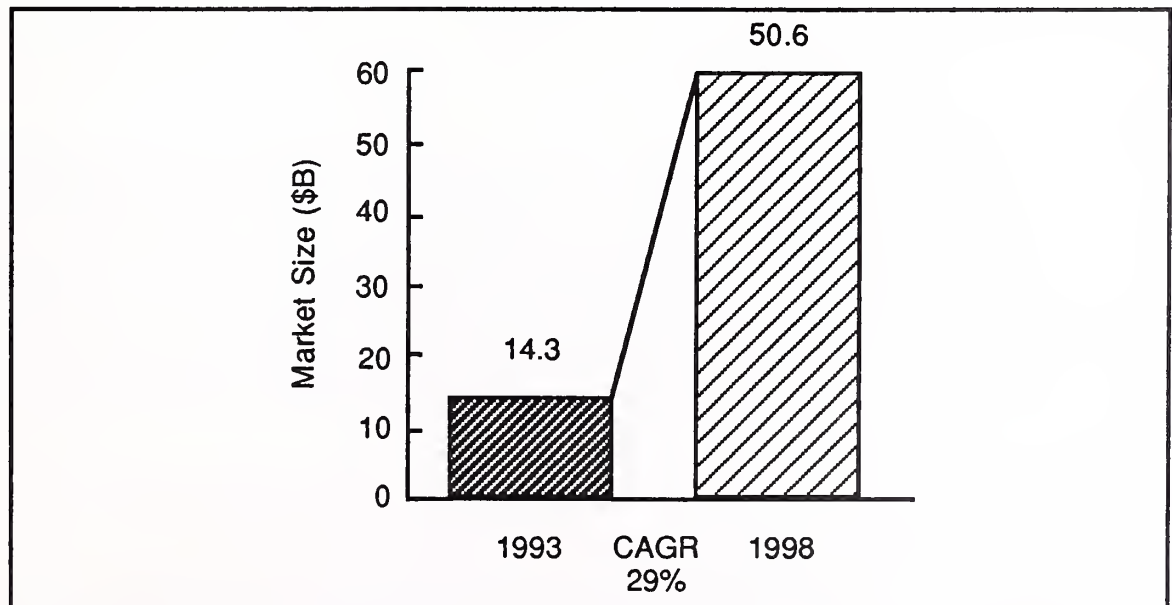
The systems software market was estimated at $5.9 billion in 1993
and the applications market at $8.3 billion (five-year CAGR 22%).
The applications market is divided into vertical ($2.8 billion in
1993, five-year CAGR 43%) and cross-industry ($5.5 billion in 1993,
five-year CAGR 21%) and software, as shown in Exhibit II-3.

EXHIBIT II-3

C/S Software Market Forecast
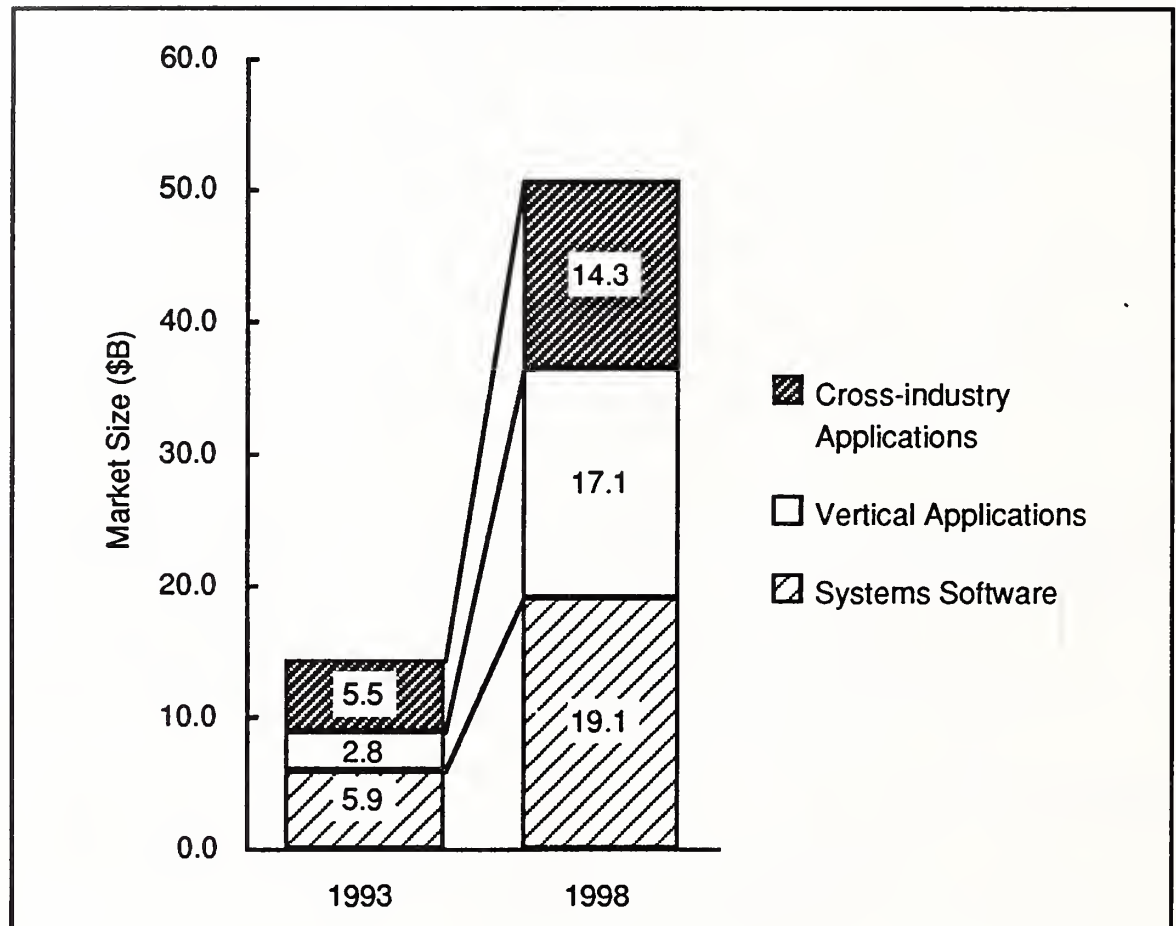
Most C/S systems are built by system integrators from application
development tools. As the market matures, more customers will
buy more applications system components based on C/S tools.
This is the approach taken by PeopleSoft, of Walnut Creek, CA
who designs C/S accounting and human resources software that
can be readily integrated into a users computing environment.

E
Summary Statistics

From a survey of 2,217 respondents, representing small and large
companies, 27% indicate that they expect to move to a C/S
architecture. In surveying mainframe-based C/S applications,

13% will be implemented by outsourcing part or all of the applications. Considering all applications, only 10% will be outsourced.

Downsizing is often cited as a reason for moving to C/S systems. This report shows there are many other reasons, including upsizing. However, 33% of C/S applications are downsized, compared with 18% for the entire sample. A high 35% of applications plan to support electronic commerce—for C/S applications, this rises to 47%.

Only 17% of respondents from companies with less than $100 million in annual revenues are implementing C/S systems, whereas 33% of companies with more than $5 billion in sales are implementing C/S systems.

F
Recommendations for Vendors

1. Invest in Objects

Vendors, if they are not already doing so, need to invest in object management. This goes beyond developing systems using object-oriented software. Vendors need to gain rights to object frameworks, software libraries and information content they can market in their area of expertise. They also need to structure their programming teams so that experienced developers can create objects, and less-experienced programmers can integrate them.

2. Invest in Networking

Networking is still a major concern. C/S systems are not as easy to install as a PBX or terminal-based systems. Users, especially smaller users, want plug-and-play applications. Major users need to access massive databases and often convert them to other platforms. Methodologies, tools and software that simplify C/S networking will continue to be in high demand.

3. Invest in Partners

Vendors need to have partners that can comarket, resell their products and develop for their environment. Vendors can no longer be alone. Critical to success in the C/S arena is the ability to support emerging products and interfaces from leaders like

Sybase, Oracle, Powersoft and Gupta. Investing in partners means more than staffing an organization with an evangelist or strategic planning manager. It may mean financial investment, in distributors and sales agents.

G
Recommendations for Users

1. Redefine the Role of Programmers

In C/S systems, senior programmers must also be system architects who design and write software. Programming and systems design are converging as more powerful object-oriented development tools emerge from companies like ParcPlace, Taligent, Easel and major hardware manufacturers. IBM, for example, has recently announced its VisualAge Smalltalk-based development environment that competes with ParcPlace's VisualWorks. These tools combine object-oriented design with applications development.

2. Understand the Platform

A few years ago the choice of platform was based on hardware, then on the operating system. Now it is based on databases and communications software. Whereas a few years ago users feared getting locked into a hardware manufacturer's technology, now they fear being driven by companies like Oracle and Sybase on the server side and Microsoft on the client side. Users can choose to:

- Simplify the system by standardizing on a few key vendors

- Allow flexibility by running multiple platforms

In practice, users will trade vendor independence for simplified integration.

3. C/S Development Cycle

The C/S system implementation process is cyclical. Workstation software and servers can be upgraded without users noticing. Users must plan for incremental development and modular software upgrades over networks.

4. Foster Technology Discussions

In the survey, several user organizations felt they had difficulty communicating their requirements to MIS or to vendors. Development groups need to set up technology teams to explain system directions to users. MIS organizations need to expose users to vendors who can describe successful implementations.

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III
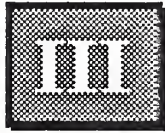
Background

This chapter defines C/S computing and summarizes alternative architectures that may be considered when implementing a C/S system. A discussion of the business forces that drive C/S implementation follows. Some common C/S definitions are discussed, with a characterization of systems that are likely to be encountered in practice.

A
INPUT's Client/Server Definition

INPUT defines C/S computing in its "Definition Of Terms" as shown in Exhibit III-1.

EXHIBIT III-1

Client/Server Definition

- *Client/server* is an architecture that assembles applications software and databases, systems software and computer and networking equipment into a usable form for the purpose of leveraging information technology investments.

- Broadly defined, it can include any kind of server, such as file servers and network servers, that are accessed by any kind of client, including a non-intelligent terminal. INPUT has elected to use the narrower and newer definition, by which application and data processing is shared between a client and a server. It is through the act of sharing that the greatest benefit is derived in terms of leveraging information technology investments. It is also the cause of the greatest change for vendors and users.

Source: INPUT

INPUT's definition of C/S includes architectures that are sometimes contrasted with client/server, such as fully distributed and cooperative processing designs. They are discussed in the following section.

B
Other Network Architectures

Whereas INPUT's definition of C/S computing is adequate for understanding market trends, when undertaking systems planning, variations on C/S architectures need to be considered. This section discusses other network architectures:

- Dumb clients

- Peer-to-peer

- Broadcast

- Store-and-forward

- Distributed processing

- Cooperative processing

This section discusses each technology and how it is related to this market analysis.

1. Dumb Clients

The industry typically refers to systems as "smart" or "dumb" depending on their logic processing capabilities. "Dumb" clients are terminals, workstations or PCs that may interact, but do not share application processing, with a server. Examples of dumb clients are:

- ASCII, ANSI, VT100 and 3270 terminals

- PCs with terminal emulation hardware, such as IRMA boards, and/or software, such as CrossTalk

A system which only has dumb clients will not generally be considered a C/S system.

2. Peer-to-Peer

Some networks, such as peer-to-peer Apple LocalTalk networks, do not have the notion of a client and server. Peer-to-peer networks are often simple to set up and maintain for small organizations. For large installations they may prove inefficient to manage.

A network with an underlying peer-to-peer architecture may run applications that have a C/S architecture. For example, one computer in a peer-to-peer network may support a database that serves other computers running as clients at the applications level as illustrated in Exhibit III-2. INPUT includes such C/S applications as C/S systems, even though the underlying network may not be C/S.

EXHIBIT III-2

C/S Application on a Peer-to-Peer Network

Client Software

Network & OS Software

Client Software

Network & OS Software

Server Database

Network & OS Software

——— C/S software linking databse to clients

▨▨▨▨▨ Underlying peer-to-peer network
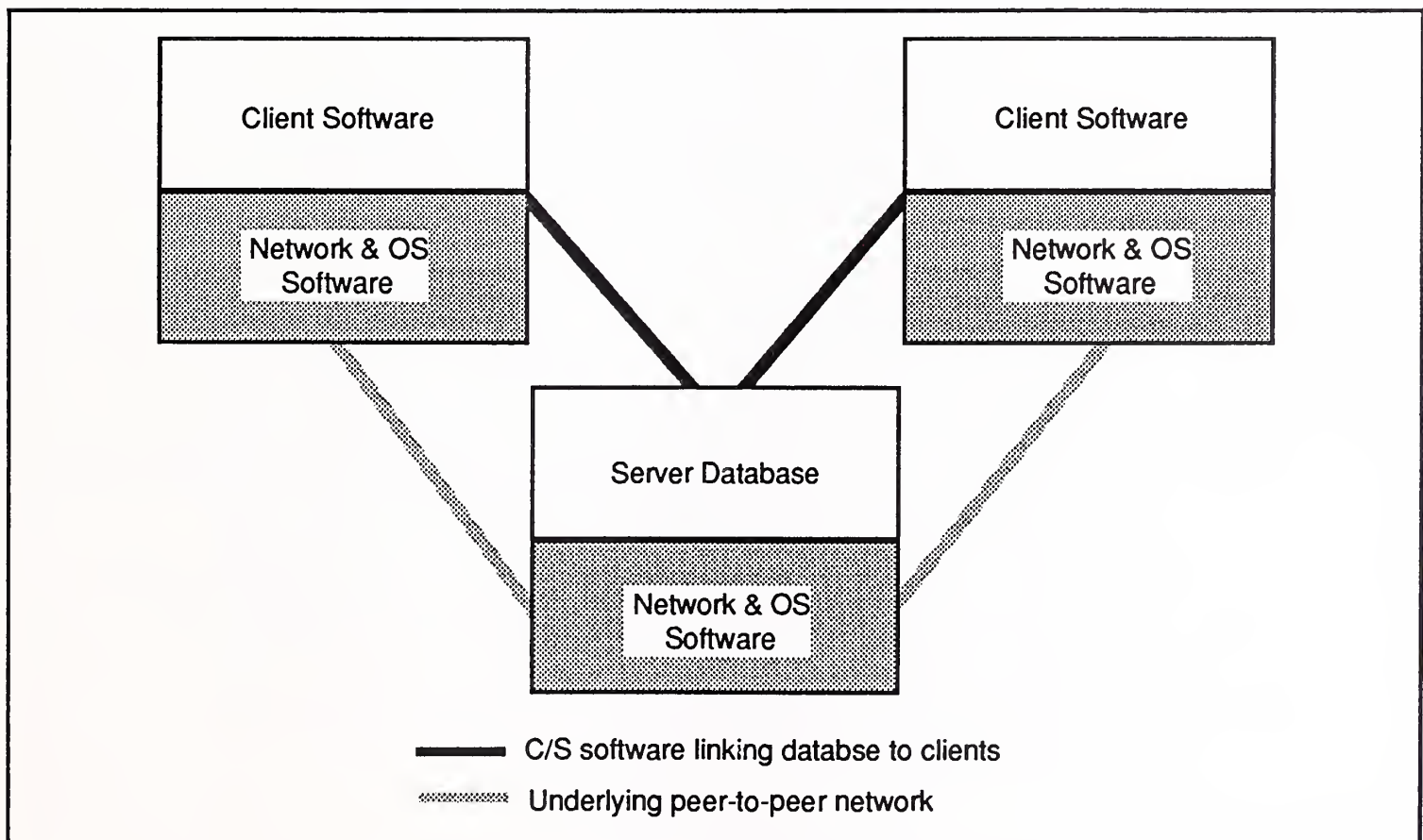
Source: INPUT

3. Broadcast

Consider an information service where PC users request daily news from a server. If each user requests a news feed during a peak busy period the server may respond slowly. Instead of the

user requesting the server to send out news, the server may be preprogrammed to broadcast at a preassigned time to each PC, without user intervention. Broadcast systems are useful when the same transaction is provided to many clients and the request can be preprogrammed in advance. Broadcast systems that merely broadcast information, like some stock quotation systems, will not be counted as C/S systems. However, if they also have C/S applications then they will be counted as C/S systems. These systems are typically found in network services environments.

4. Store-and-Forward

Many electronic mail networks are based on store-and-forward processing. Store-and-forward communications can take place at many levels and with varying time intervals. In a transaction processing network delays may be measured in seconds, in an electronic mail network, in hours.

Increasingly, middleware such as Transarc's Encina transaction monitor, supports message-based queuing in C/S systems. Transaction processing monitors that use message queuing at the systems software level will be included as C/S software.

In a simple C/S system, a session between a client and server takes place in real-time. In a store-and-forward system, the client sends a message to the server then drops the connection. The server processes the request and stores the response until a later time when it may be sent to the client. Traditional electronic messaging systems like IBM's PROFS and cc:Mail are considered store-and-forward systems and will not be counted as C/S systems. However, systems like Lotus' Notes and advanced mail systems, characterized by interprocess communications with a server and shared processing, will be counted as C/S systems. In particular, messaging systems will become a conduit for intelligent agents and objects. They will become part of C/S systems.

5. Distributed Computing

The term "distributed computing" usually includes, but implies more than, "C/S". Distributed computing is used to describe systems where applications (including data) run across multiple computers as if they were logically one machine to the programmer. In a fully distributed database, every node may be a

client and a server—there may be multiple servers. Distributed computing is sometimes considered a more advanced technology than C/S. In this report, INPUT views distributed computing as an advanced C/S architecture, hence, it is included in this forecast. Many C/S systems will evolve into fully distributed systems.

6. Cooperative Processing

In a cooperative processing design the data may be centralized but clients may each process the data across a network. INPUT will count this architecture in its C/S forecast.

C
Software Classification

This report will analyze the software market for C/S systems. Software products include packaged software and licensed rights to software. Custom software (for example, contract programming), developed as work for hire, is not included in the forecasts in this report as INPUT includes it under professional services. Software developed as part of a systems integration contract is included under systems integration and not included in this report.

The C/S software market will be analyzed using the following standard INPUT categories:

- Systems Software

    - Systems Control

    - Operations Management

    - Applications Development Tools

    - Database Management Systems

- Applications Software

    - Cross-industry Software

    - Vertical Market Software

The Systems Software and Applications Software categories are shown in Exhibits III-3 and III-4.

Systems Software

```
                    ┌─────────────────┐
                    │    Systems      │
                    │    Software     │
                    └─────────────────┘
```

Systems Control	Data Center Management	Applications Development Tools

Systems Control
- Access Control
- Communications Monitors
- Micro-Mainframe Links
- Network Control
- Operating Systems
- Security Systems
- System Library Control
- Windowing Systems
- Other

Data Center Management
- Capacity Management
- Computer Operations Scheduling
- Data Center Management
- Disk Management
- Downtime/Repair Monitoring Management
- Job Accounting
- Performance Monitors
- Tape Management
- Utilities
- Other

Applications Development Tools

Program Development and Production Tools
- Applications Generators
- Assemblers
- Automatic Documentation
- Configuration Management
- Debugging Aids
- Languages (All Generations)
- Systems Development Control
- Retrieval Systems
- Translators
- 4GL
- I-CASE
- Other

Database Management Systems
- Database Management Systems
- Data Dictionaries
- Other

EXHIBIT III-4

Applications Software

```
                    ┌──────────────────┐        ┌──────────────────┐
                    │   Applications   │        │     Turnkey      │
                    │ Software Products│        │     Systems      │
                    └──────────────────┘        └──────────────────┘
                         │                              │
                  ┌──────────────┐              ┌──────────────┐
                  │    Cross-    │              │   Industry-  │
                  │   Industry   │              │   Specific   │
                  └──────────────┘              └──────────────┘
```

Office Systems	Accounting	Human Resources	Education & Training
• Integrated Office Systems • Word Processing • Desktop Publishing • Image Systems • Electronic Publishing • Document Imaging Software	• General Ledger • Accounts Payable • Accounts Receivable • Billing/Invoicing • Costing • Fixed Assets • International Accounting • Purchasing • Taxation	• Human Resources Management • Payroll • Benefits	• Computer-based Training • Authoring Languages

Industry-Specific

- Discrete Manufacturing
- Process Manufacturing
- Transportation Services
- Utilities
- Telecommunications
- Retail Distribution
- Wholesale Distribution
- Banking and Finance
- Insurance
- Health Services
- Education
- Business and Technical Services
- Federal Government
- State and Local Government
- Miscellaneous Industries

Planning & Analysis	Engineering & Scientific	Other Cross-Industry
• Executive Information Systems • Financial Modeling and Planning • Spreadsheets • Project Management	• Computer-aided Design and Engineering • Structural Analysis • Statistics/ Mathematics/ Operations Research • Mapping	• Marketing Management • Sales Analysis

Information content, which will be excluded from the 1993-1998 forecast, offers C/S system integrators and users opportunities to

generate additional revenue. It is likely to be of growing importance as the software industry matures and includes:

- Online database information

- Electronic documents, templates

- Publicly available mailing lists

- Digital media—clip-art, presentations, video, sound bytes

D
Motivation for C/S Systems

1. Business Motivation for C/S Systems

C/S systems address major business needs to:

- Respond to customers quickly

- Manufacture just-in time and with custom features

- Support PC users with instant, accurate information

- Reduce headcount by merging jobs and reducing supervision

C/S systems are revolutionizing customer service for industrial and retail customers. Manufacturers can be linked to distributors and stores. Consumers can obtain videos from kiosks over networks. Customer service representatives in telephone and utility companies can access engineering databases using C/S systems.

Using C/S technology for electronic commerce accelerates business ordering. Vendors gain market information when they can access consumer data from C/S systems. Equipping service representatives with workstations enables them to offer superior customer support.

Integrating databases from different sources and processing the information on a client workstation can improve decision making in executive offices, hospitals, factories and retail stores. The processing power of the PC can be harnessed to display information graphically and simply.

On the one hand, C/S technology frees the IS organization. As C/S development tools become easier to use, programming moves from IS to user organizations. On the other hand, it creates extra demands. As demand for video and multimedia increases, IS

departments need to upgrade networks, servers and workstations. It is harder for an IS organization to maintain PCs than terminals, which generally do not need to be configured once installed.

Users who cannot develop their own applications engage outside service providers and system integrators. Hence, the deployment of C/S systems is typically accompanied by a shift to external system integrators, outsourcers and packaged software vendors.

Legacy systems often contain mission-critical data that can be accessed using a C/S system. Organizations typically move to C/S systems because they want to change their operations in one of the ways shown in exhibit III-5.

Motivation for Implementing C/S Systems

- Outsource—offload the operation of systems to a third party
- Upsize—add more powerful servers to a PC network
- Downsize—deploy lower cost systems and reduce headcount
- Connect—access customers, suppliers, information
- Innovate—support multimedia, video, sound, visualization

Source: INPUT

a. Outsourcing

In the user survey, for each application respondents were asked if they planned to outsource. Applications such as accounting and human resources are most likely to be outsourced, according to the survey. Also, in the health services and transportation industries, networked systems are frequently outsourced.

Of the 2,986 applications, approximately 10% will have some part of the application outsourced. With or without a C/S migration strategy, the percentage was 10%. However, for mainframe applications, C/S applications are more likely to be outsourced.

Approximately one-third (1,026 out of 2,986) of applications have a mainframe as part of the platform. These applications may also run on minicomputers or LANs.

A customer may wish to replace a legacy mainframe with a RISC-based server. An increasingly popular migration strategy is for organizations to contract with an outsourcing firm (who may be the vendor of a new system), to run mainframe legacy applications. The mainframe can be connected to the newer computers. This frees internal resources to develop new C/S systems. An open question is whether this is a temporary situation, or whether there will be a longer term need for the mainframe application. This depends on the willingness for the user to invest in replacement applications.

Analyzing applications that included a mainframe as a component, 13% (43 out of 332) of C/S applications and 9% (64 out of 694) of non-C/S applications are outsourced (see Exhibit III-6). Of 1,026 applications that have a mainframe as a major component, 107 or 10% are outsourced. Hence, if an application is running on a mainframe and is migrating to a C/S architecture it is slightly more likely to be wholly or partially outsourced.

EXHIBIT III-6

Proportion of Mainframe Applications Using Outsourcing
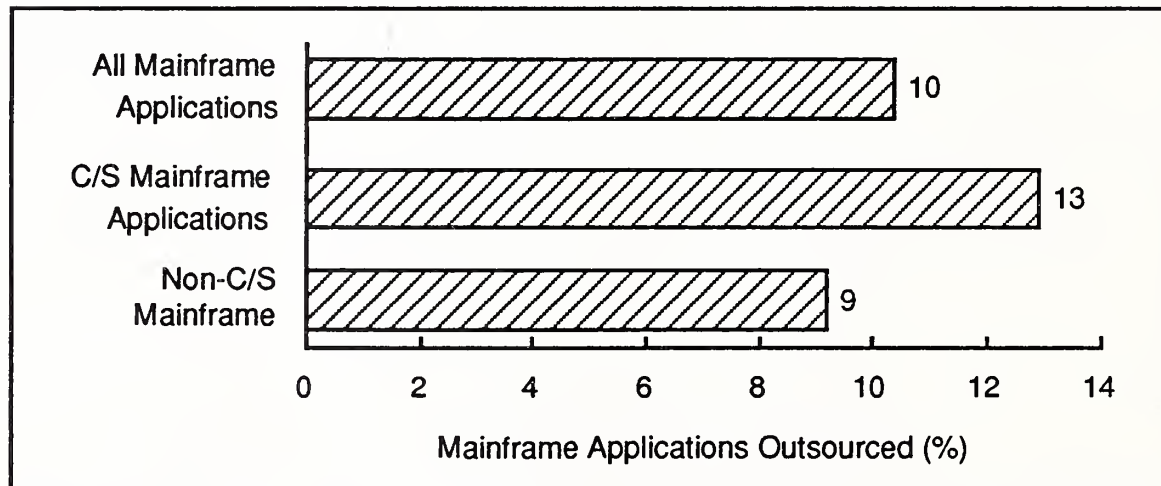
Considering just the applications that are outsourced, on average, 36% are implemented using a mainframe as a primary platform. Of the outsourced applications, 42% of those implemented using a C/S architecture use mainframes and 32% of those *not* using a C/S architecture use mainframes. This supports the hypothesis that outsourced C/S systems are more likely to have mainframes as part of the applications platform (see Exhibit III-7).

EXHIBIT III-7

Percentage of Outsourced Applications Using a Mainframe

All Applications — 36
C/S Applications — 42
Non-C/S Applications — 32

(x-axis: 0, 10, 20, 30, 40, 50)

Outsourced Applications Using Mainframe (%)
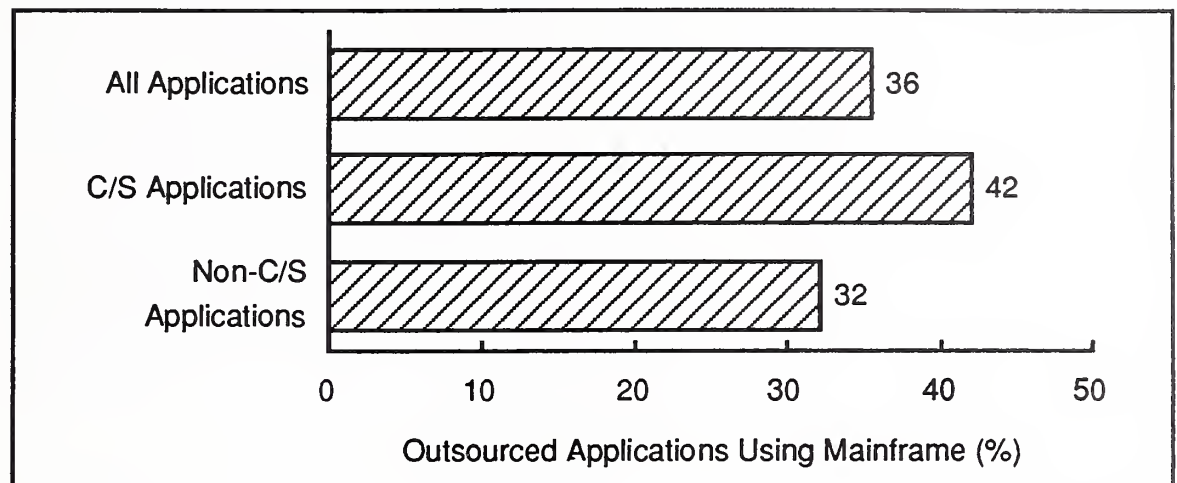
b. Upsizing

Growing organizations in the user survey indicated that a prime reason for moving to C/S systems is to organize their business processes. Whereas large, established companies are keen to reduce costs, smaller ones are intent on being efficient, well-organized and responsive.

c. Downsizing

The move to C/S is sometimes associated with downsizing. Indications are that the downsizing trend of a few years ago is slowing. Exhibit III-8 shows the percentage of applications downsized. Note that C/S applications are more likely to be downsized.

EXHIBIT III-8

Percentage of Applications Downsized

All Applications — 18
C/S Applications — 33
Non-C/S Applications — 11

(x-axis: 0, 5, 10, 15, 20, 25, 30, 35)

Percentage of Respondents (%)
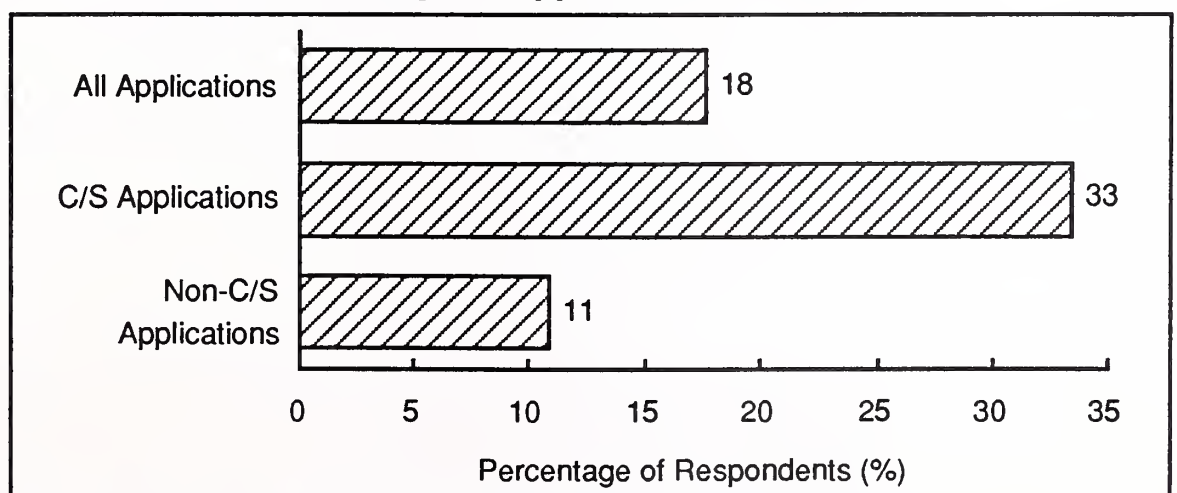
Source: INPUT User Survey 1993

d. Connecting

A key reason for moving to C/S systems is to access information and speed business decision making. Users want to connect using WANs and LANs. Of the 2,986 applications surveyed, 1,026 (34%) will be implemented using a LAN for part of the system.

A key reason for connecting is to conduct business using electronic data exchange (EDI). Of the 2,986 applications, 1,048 (35%) plan to use EDI. Exhibit III-9 shows that 47% of C/S applications (424 out of 908) and 30% of non-C/S applications (624 out of 2,078) plan to use EDI.

EXHIBIT III-9

Percentage of Applications Using EDI
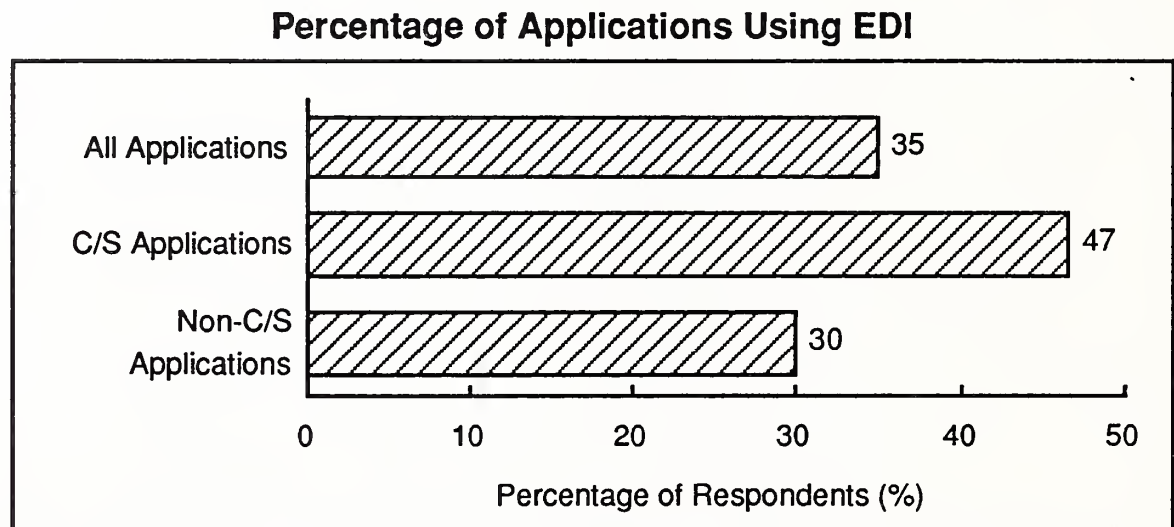
Source: *INPUT User Survey 1993*

e. Innovating

Innovative users move to C/S to integrate 3-D graphics, maps and multimedia into systems. Vendors listed below are just a few of the many that support innovative applications:

- Silicon Graphics—3-D visualization and simulation

- InterGraph—Geographic information systems

- Apple—Multimedia

Desktop videoconferencing is an application marketed by major workstation manufacturers. As standards become established, an opportunity for C/S software and system vendors will be to integrate videoconferencing with applications software. Research shows that videoconferencing users want to exchange more than

"talking heads," they will need software to transmit documents, diagrams, animations and messages.

2. Vendor Motivation

C/S is heavily promoted by hardware manufacturers, system integrators and database vendors. As hardware prices decline, traditional hardware vendors look to C/S system integration to augment their business and use their networking expertise. C/S computing offers system integrators with an opportunity to offer open solutions that are not locked into any one hardware platform.

Database vendors are attracted to C/S solutions because they expand the range of data processing applications and enable users to access multiple databases from one workstation. With multimedia support for video, images, sound and graphics in client workstations, C/S computing allows system integrators and software vendors to provide applications and services that only a few years ago were prohibitively expensive.

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IV

Issues and Concerns

This chapter covers customer and vendor concerns. The customer concerns are derived from the user survey. The vendor issues were raised in face-to-face and telephone interviews.

A
Customer Concerns

From the user survey, the concerns mentioned fall into three main areas:

- System functionality—Do the system features work as planned?

- Users—Are they taking full advantage of the system?

- Business issues—Does the system enhance business?

1. System Functionality

C/S systems require radically different operations management from mainframe systems. Instead of sitting at a console in a computer center, a system administrator has to visit users' offices to check disk drives and cables. Fortunately, C/S system management tools are rapidly deployed by companies like OpenVision. Users expressed the following concerns as shown in Exhibit IV-1.

a. Networking

Networking between corporations is frequently cited as an issue.

There are two major issues:

- Integration complexity

- Performance

In particular, electronic commerce applications with inter-company communications present challenges for the C/S system integrator.

EXHIBIT IV-1

System Issues

- Networking—electronic commerce, protocol alternatives, APIs
- Security—encryption, keys, digital signatures
- Infrastructure—PCs, servers, networks
- Performance—improve with hardware, OS , transaction monitor
- Reliability—opportunity for test tools
- Scalability—from palmtop to mainframe

Users are overwhelmed by the choice of networking protocols. They are also unclear as to which network architectures are appropriate. TCP/IP network protocols that started in the UNIX environment, are increasingly used for connecting PCs to servers over Ethernet. Companies driven by server applications based on products like Oracle, usually use TCP/IP. In Novell networks, IPX is an alternative that will continue to be used by companies that are driven by networked PC applications. Standards driven by major vendors, like IBM's LU6.2 and Apple's LocalTalk, will continue, but will be increasingly under pressure from TCP/IP and its derivatives. System architects that understand a wide range of networking and software issues will continue to be in high demand by developers of C/S systems.

Major efforts by software vendors and industry groups are standardizing application programming interfaces (APIs). For example, Microsoft's Open Database Connectivity (ODBC) interface provides a standard for client software to access databases. Vendors like Oracle and Sybase have more powerful proprietary interfaces, so system designers need to trade-off standards versus functionality.

Object-oriented development platforms mask the complexity of underlying network architectures, so many of the programming

interface issues will migrate from systems software levels to applications levels. Over the next five years the issues will change from standardizing network protocols and interfaces between development tools, to defining common data formats and objects.

Networking performance is a bottleneck, compared with the performance of a symmetric multiprocessing (SMP) server. Ethernet networks, with a throughput of little more than 1Mbyte per second in practice, are not fast enough to carry the traffic for many transaction processing applications. Comparison of network speeds found in typical C/S environments is shown in Exhibit IV-2.

EXHIBIT IV-2

Communications Speeds in a C/S Network

Network Component	Practical Communications Speed (Megabytes per Second)
Ethernet LAN	1
FDDI fibre-optic corporate network	10
Internal communications in an SMP server	250–1,200

Source: INPUT

Repetitive database queries can be written as a script once and stored as a "stored procedure." Stored procedures are a popular feature of modern C/S systems. Exhibit IV-2 explains why stored procedures that carry out repetitive requests from a client are usually kept on the server. When a client makes a query instead of sending the complete query over the network, the client accesses the procedure stored on the server and saves network bandwidth.

b. Security

Users, in particular those experienced at administering mainframes, are concerned about distributed systems security. They expect to have the same security on a network as on a mainframe. Many users are unaware of the range of security tools for UNIX systems that can make them as secure as a mainframe.

Security concerns also result from differences in perception. The mainframe environment is analogous to a corporate office. Office employees have coded keys that lock each office and the computer center has special locks that prevent all except the privileged few from entry. In the UNIX environment, security is traditionally implemented to resemble that of a medieval fortress. There is a moat and drawbridge to keep out enemies. Once inside the castle wall people roam freely. If the gatekeeper leaves the drawbridge down maybe the odd enemy gets inside.

The promise of the Open Software Foundation's (OSF's) Distributed Computing Environment (DCE) technology is to bring mainframe like security to C/S systems. Security is integrated more into C/S systems in several ways:

- Encryption

- Keys

- Digital signatures

- DCE

- Security management systems and services

Encryption may be time consuming and costly for all file transfers. One of its main uses is between companies or for access by mobile users to public network services. Encryption of all messages may be desirable for wireless communications. MIT's Kerberos (named after the mythical three-eyed guard dog Cerberus) system and RSA's public key encryption algorithms are gaining popularity. Apple has recently released its PowerTalk software that has security features for mail and fax communications including digital signatures based on public/private keys. A major reason for using the Open Software Foundation's DCE middleware is because it provides security across networked computers. Emerging companies like OpenVision are addressing the security issues surrounding C/S computing.

c. Infrastructure

Once C/S systems move from pilot to production, PCs and networks are usually upgraded. Too frequently, older PCs are provided with Windows and applications software, only to run into

problems because they lack sufficient memory, display size or disk space. In some cases expanding server capacity can actually slow the system as a whole because more users request services. Add multimedia or video-conferencing and network performance can become slow. For a complex C/S environment capacity planning must be taken into account before systems are deployed.

d. Performance

A concern raised is client workstation performance. Systems managers have reported instances where Windows machines are slower to display data than 3,270 terminals or DOS-based PCs. Various technologies can be applied to improving the performance of C/S systems including:

- Windows accelerators and memory—RAM (computer main memory) and VRAM (video memory). PCs need at least 8MB and preferably 16MB to run many C/S applications.

- Multitasking and multithreaded operating systems—OS/2 and UNIX process multiple applications simultaneously. OS/2 is multithreaded as are some UNIX versions. If a user is querying a database, creating a report to print and receiving messages from servers then the Windows 3.1 operating system's task switching is inadequate. Windows 4 (Chicago) will improve a client's PC ability to run multiple applications simultaneously.

- Transaction monitors—AT&T Global Information System's (was NCR's) Top End, Transarc's Encina and Novell's Tuxedo can be used to optimize transaction scheduling, thereby improving performance.

e. Reliability

On the one hand, C/S systems are more reliable because if a client PC fails, it can readily be replaced and processing can continue. On the other hand, C/S system integration testing is difficult. Initial implementations of C/S systems are almost always unreliable. An opportunity is in tools for testing C/S system configurations and tuning performance.

f. Scalability

Most users are looking for scalable systems so that a small work group can be supported with the same software as a larger operation. Windows NT offers a server upgrade path that is compatible with Windows clients.

Some users are managing scalability on servers using a range of UNIX machines. This is where Hewlett-Packard has had considerable success as they offer HP-UX workstations for the low-end up to high-performance superservers. They also, through Sequoia, offer a fault-tolerant UNIX server, however there is a considerable performance penalty on these machines. From the palmtop to the supercomputers, Sun Microsystems also offers a scalable hardware environment.

Novell is expected to promote desktop UNIX as its scalable solution. However, Microsoft is strategically poised to have the leading scalable architecture.

2. User Issues

Too often companies look at the programming cost and the system component cost, but forget about the costs associated with users. By addressing user concerns (see Exhibit IV-3), companies can significantly enhance the performance of their organization.

EXHIBIT IV-3

User Issues

- User training—especially in health services and retailing
- User interfaces—not all users prefer mice and windows
- Inter-departmental communications—especially with IS and users
- Information overload—address this with C/S information systems

Source: INPUT User Survey

a. User Training

Particularly in retailing and health services, user training is a major issue. In retailing, because the turnover is high, and in

health services, because some health care professionals are reluctant to use computers. Besides learning how to use C/S systems, users need to be trained in keeping the system running. Online support, centralized network maintenance and frequent interaction with system administrators simplifies user support in a C/S system.

b. User Interfaces

Tools like Gupta's SQL Windows, Microsoft's Visual Basic, ParcPlace's VisualWorks and Powersoft's PowerBuilder have greatly simplified the development of Windows-based client software. In addition, personal computer databases can retrieve and display data. Personal computer databases lack features like integrity and security, but their simple screen generators coupled with OLE or Apple Events make them adequate for rapid-prototyping and small-scale systems. Windows-based screens are notorious for producing multiple overlapping windows. Heavy system users usually find function keys and on-screen buttons superior to pull-down menus and mice. Many vendors make user interfaces too complex. The move to object-oriented frameworks will push designers to create simpler screens.

Microsoft's Cairo and Taligent's application frameworks are more communications-oriented and document-centric than previous operating environments. This means that data processing will be more closely integrated with messaging and office automation. For example, corporate data will be embedded in reports. "Drag and drop" user interfaces are expected to become standard. They will be more common for office automation applications than for data entry.

c. Interdepartmental Communications

C/S systems are often interdepartmental. Several survey respondents mentioned that, if IS and user departments had communicated more in the initial phases of system implementation, their C/S implementation would have been more successful. This presents its own challenges as communication patterns change with the implementation of a C/S system. Interdepartmental teams are one way organizations are solving potential communications problems as C/S systems are implemented.

d. Information Overload

Most users have too much information, therefore, systems that can process data intelligently and display just the required information, are valued. C/S technology is ideal for this type of system, rules can be provided by the user to sift data. Workflow and messaging systems that sort electronic mail according to business rules are an example of this class of system.

3. Business Issues

Business needs to be flexible, hence systems must be constantly able to change. Mainframe systems that cannot be modified by the user cannot respond fast enough to changing environments. In C/S systems, the user can usually change reports very quickly and new modules can be added using outside resources as necessary.

a. Corporate Culture

C/S systems frequently disrupt corporate culture. As computer power is distributed from central organizations, user organizations become empowered. Different organizations have various solutions to managing culture change, some have team role-playing meetings to bridge organizations.

EXHIBIT IV-4

Business Issues

- Corporate culture—C/S systems change power structures
- Telecommuting—C/S remote support required
- Business rules—flexible systems from C/S with objects
- Cost—depends on the application, cost-benefit studies
- Efficiency—main driver for C/S system implementation
- Pricing—vendor trend toward simplified pricing

b. Telecommuting

Having set up a C/S applications, companies may find it cost-effective to have home office links for telecommuters. In most areas affordable communications are possible using switched megabit data services or ISDN. Products like AppleTalk Remote and cc:Mail Remote enable Apple Macintosh and cc:Mail users,

respectively to link into their office computers using portable computers or home computers over phone lines.

In the industrial revolution home workers were driven back to the factories with the advent of water power so that they could weave cost effectively. In the information age, the cost of maintaining communications and information exchange to home offices may, in the long run, become prohibitive. Home workers will migrate back to offices where they can have multimedia video-conferencing, access to massive corporate databases and interaction with coworkers. Some companies have temporary offices with phones and computers that can be set up using remote system administration for mobile professionals.

c. Business Rules

Business process re-engineering frequently accompanies C/S system implementation. A key user concern is that the software can change with the business. A major trend in C/S system development tools is to incorporate business rules into the software. Users are concerned that they may not have designed the right processes into their software. The software development process needs to support small modular interchangeable C/S system components that can be thrown away and reused. This is the promise of object-oriented programming. Easel's Synchrony application development software takes this approach.

d. Cost

There has been much debate as to whether C/S systems reduce costs or increase revenues—it depends on the application and how it is implemented. There are clear cases where mainframes have been replaced by C/S systems with UNIX servers with considerable savings. Many organizations implement C/S systems without undertaking careful cost-benefit studies, arguing that they are unable to estimate costs. Whereas a detailed study may not be possible, an attempt to analyze costs and benefits will usually be beneficial. Many new C/S systems are justified because they increase sales.

e. Efficiency

Users cite efficiency as a prime reason for moving to C/S systems. Applications making full use of communications networks show

incredible business performance improvement. In particular, linking databases together electronically can reduce time taken for processes like shipping and ordering, from days to minutes.

f. Pricing

On the one hand, users want simple pricing and on the other, vendors do not want to undercharge. C/S system pricing is frequently mentioned as complex. OpenVision has three software categories and three types of platforms. The price list is an easy to understand 3 by 3 grid. Established software vendors, especially those supporting mainframe products with mainframe prices, frequently find it hard to develop simple pricing models. Vendors that provide simple pricing are at a strategic advantage. They reduce the cost of selling by eliminating lengthy negotiations.

B
Vendor Concerns

1. Product Engineering

a. Time to Market

As with any product development, the time it takes to launch a product and get it to the market is critical. Vendors of C/S software require development tools that can decrease their time to market. A C/S software product requires more integration testing than with a standalone product.

b. System Complexity

A concern regarding C/S systems that span multiple platforms is that they are more complex than a system residing on a single computer. Few companies are bold enough to discard their Windows machines for UNIX workstations, even if they start at less than $5,000 each, to create a homogeneous UNIX-based network. However, those that can justify doing so, for example in customer service systems for utilities, development has been less complex than trying to integrate Windows PCs into the system.

A bank aiming for a homogeneous environment tried using Oracle on an Apple server running A/UX (UNIX) with Apple Macintosh clients. This system proved easier to administer, robust and more cost effective than any other evaluated C/S

platform. IS resisted deploying the system as it would require replacing standard PCs with Macintoshes.

According to the user survey, IS departments are often responsible for selecting the computing platforms and infrastructure. In the interest of standardization this may result in suboptimal performance for user groups. The trend set by large companies, like General Motors, to implement standard environments, can be expected to trickle down into smaller companies to reduce the variety of system platforms.

c. Platform Selection

Client and server software vendors must offer cross-platform products to compete. Vendors who supported OS/2 too early suffered from poor choice of platform. The biggest risk today is overdependence on mainframe products. Some software vendors have seen their mainframe revenues plummet dramatically, a 50% drop in one year not uncommon, as C/S tools are developed. Most mainframe vendors are cannibalizing their own product line by either developing or acquiring C/S tools. For example, Bachman Information Systems acquired Cooperative Solutions (Mountain View, CA) as a supplier of system design software. Companies that develop C/S tools for accessing IBM mainframe DB2 databases, like BMC Software (TX), are still growing but are vulnerable. They need to diversify to support a wider range of servers.

2. Marketing

a. Channel Management

According to the user survey, even for large complex systems, many users purchase their PCs from mail order and superstores through companies like Gateway 2000, Dell and CompUSA. As established workstation and minicomputer vendors reduce prices, they are unable to get the distribution economies of scale that retailers afford PC vendors. UNIX has never been successful in the retail channel—it was tried by Fortune in the early 1980s, NeXT in the late 1980s and Novell with UNIXWare software. VARs and dealers generally do not have the distribution capabilities of a retailer. Regarding C/S applications software, as the technology matures, one can expect national distributors and

specialized mail order catalogs to address workgroup, departmental and small business C/S applications.

b. Sales and Marketing Costs

Closely related to channel management is the cost of supporting the sales force. When a technology is new, premium prices can be commanded. However, as the technology matures, direct sales by smaller vendors will not be economical.

c. Alliance Management

Vendors must structure their organization to support alliances of suppliers, vendors and investors. Ensuring that C/S system components work together and distribution is efficient requires smaller vendors to partner with larger players. Partnering enables companies to keep up with technology and gain access to that technology before it is officially released. Major vendors partner with each other for competitive advantage. Partners may be suppliers, customers, investors or any combination thereof. Managing such relationships requires considerable executive time, particularly for small companies.

V

Trends

This chapter reviews how C/S systems have evolved, then analyzes organizational trends. It then considers application, platform and technology trends.

A
Client/Server Evolution

PCs were first linked to mainframe and minicomputer databases using terminal emulation boards. Then access to mainframe data was achieved through products such as Easel and Mozart. These pre-C/S products acted more like intelligent terminal emulators than integrated application development environments.

First generation C/S software development tools, like Gupta's SQLWindows and PowerSoft's PowerBuilder, can program databases and provide some interaction with design tools. They fail to support enterprise-wide applications well because they cannot:

- Run across the range of clients and server databases supported in the enterprise

- Generate high-performance code

- Handle multiple databases simultaneously and efficiently

UniFace supports multiple databases simultaneously and is suitable for many client platforms, including the Macintosh. It is considered a second-generation tool because it supports a wide range of clients and servers. It is, however, a mature product with a user interface that needs updating. Dynasty Technologies is an emerging vendor that markets a cross-platform scalable system to generate high-performance C-code.

A third-generation of C/S products will emerge to integrate multiple C/S systems using object-exchange and store-and-forward messaging. To some extent, message queues are already available in products like Transarc's Encina, but messaging will move more to the applications level.

In a network of databases, establishing the rules of interaction becomes complex as the number of applications grows. Databases, where the owner of the database sets the rules for interaction with other databases, are known as "federated databases". C/S systems will evolve to become collections of federated databases with links that resemble electronic mail messages between systems, as shown in Exhibit V-1.

EXHIBIT V-1

C/S System Generations

3rd Generation
Systems Built Using Objects from Sun/NeXT, IBM/Apple/Taligent/HP

2nd Generation
High Performance C/S - Uniface, Dynasty, Forte

1st Generation
GUI-oriented C/S - PowerBuilder, Visual Basic, Enfin, SQL Windows

Pre-C/S
3270 Terminal Emulation, Screen Capture - Mozart, Easel
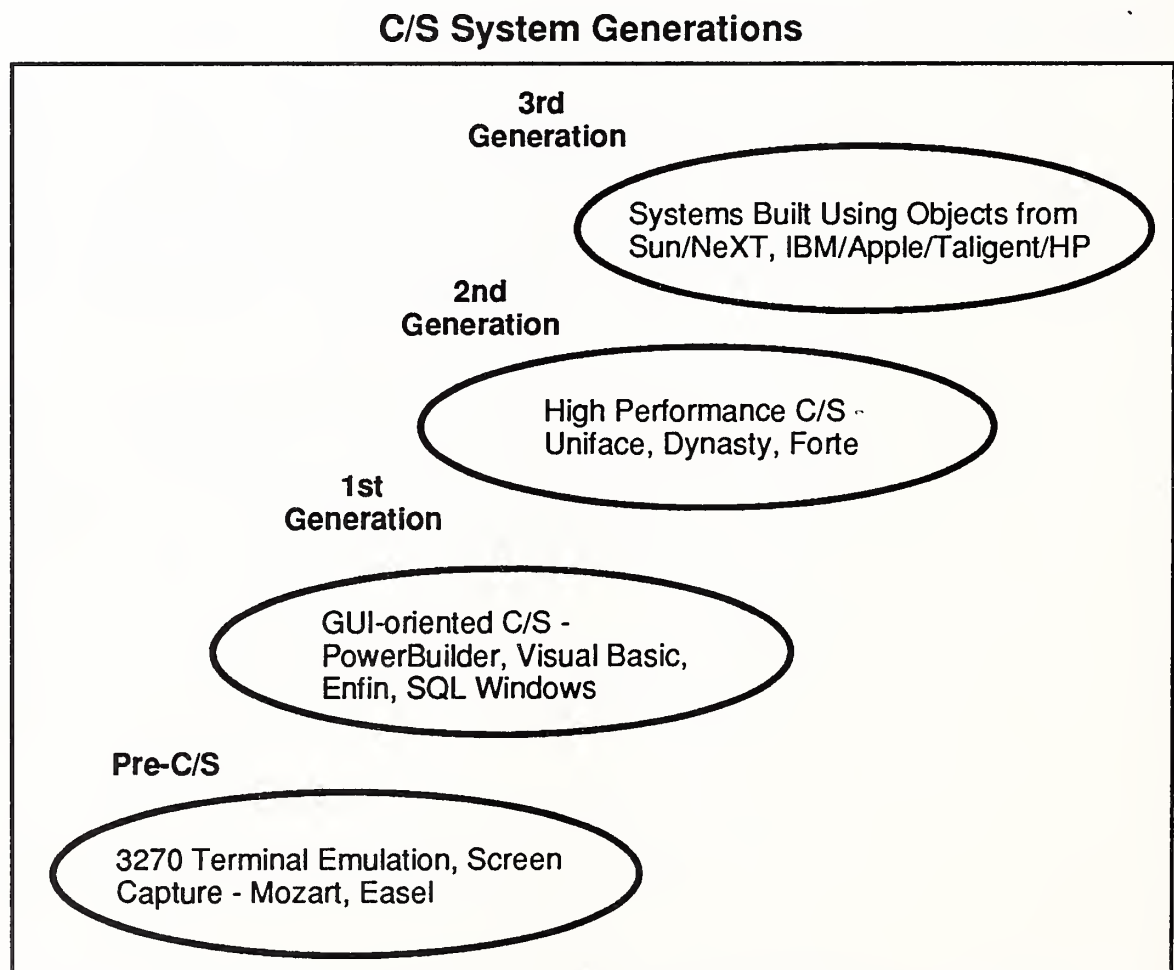
B
Organizational Trends

This section discusses C/S system trends in departmental computing, small businesses, interdepartmental (intracompany) communications, intercompany transactions and remote user support.

1. Departmental

Departmental C/S applications are less likely to be managed by central IS than enterprise-wide systems. Departmental systems traditionally ran on minicomputers, increasingly they ran on PC LANs. In departmental systems, users are usually responsible for system requirements. A key concern of departmental system users is that their systems be easily upgradable and scalable.

Departmental C/S systems are growing with:

- Specialized servers for communications, document workflow and departmental information.

- Powerful Windows NT, the Intel-based server from Tricord, NetFrame and Parallan. Also on RISC processors from Digital, NEC and NetPower.

- Departmental database environments based on user databases like Lotus Approach, SQL servers and newer databases like Microsoft Access. Borland's dBase for Windows is expected to be a player (due summer of 1994).

2. Small Business

In the user survey, only 17% of respondents from companies with less than $100 million in revenues indicated they were adopting a client/server strategy, compared to 27% for the entire sample. C/S implementation varies with company size, 2,271 respondents provided the results shown in Exhibits V-2 and V-3 when asked if planning to migrate to a C/S architecture.

EXHIBIT V-2

Migration to C/S by Company Size
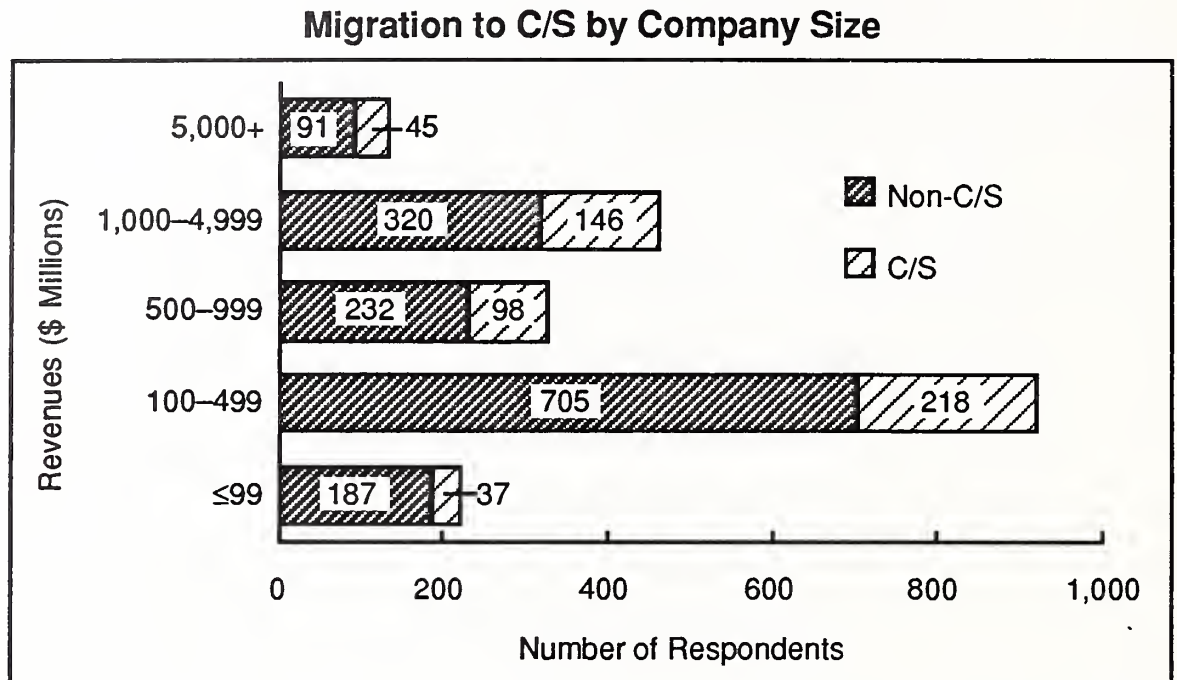
2,271 Respondents

EXHIBIT V-3

Percentage Migration to C/S by Company Size
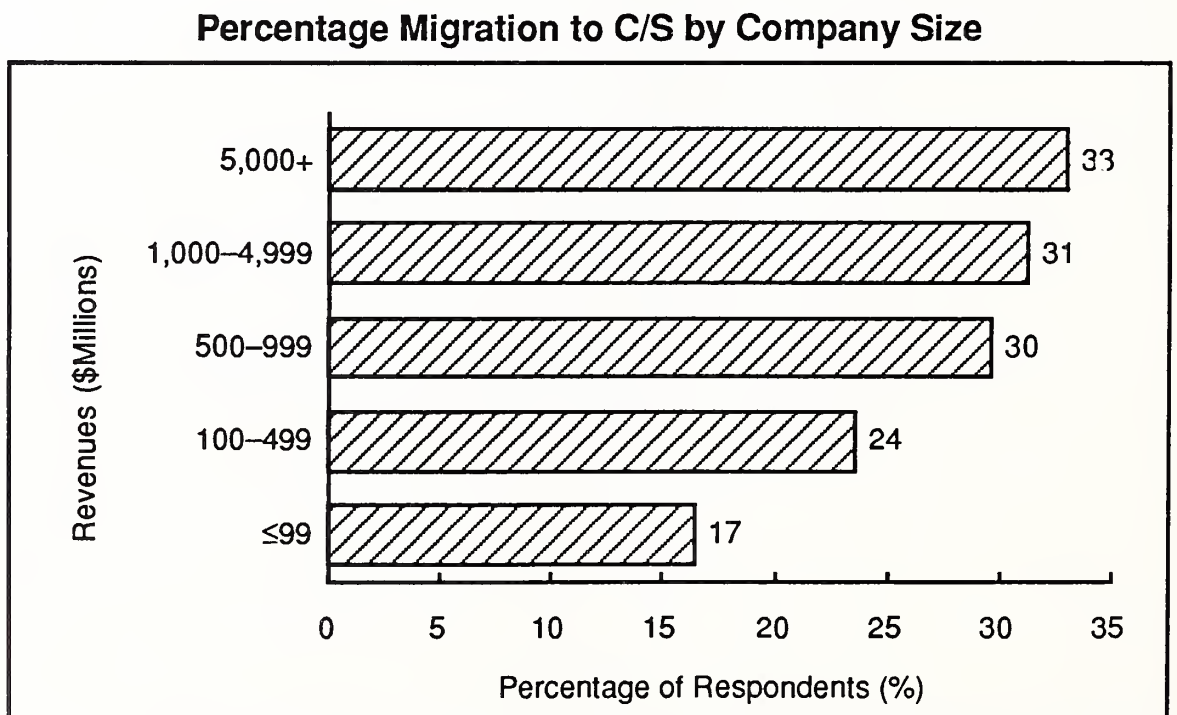
2,271 Respondents

As can be seen from the user survey, today, C/S implementation is more likely to take place in larger companies. It is the large companies that have massive investments in PCs and legacy data.

Very small companies can manage with networked PC applications or host-based solutions, rather than C/S databases.

3. Intracompany

Companies are using C/S architectures to avoid management of duplicate data across corporate divisions. C/S networks are the foundation for providing access to corporate information whether it be accessed as data records, electronic documents or multimedia. C/S software will integrate office automation applications, like Microsoft Office, with databases. This will be accomplished through distributed objects, using Microsoft's OLE and OMG's CORBA standards, as well as through messaging like that provided in Lotus Notes and Novell's Netware 4. Novell's acquisition of WordPerfect emphasizes the trend toward integrating office applications with networking. Desktop videoconferencing, currently used on private corporate networks, will increasingly be used for external communications.

4. Intercompany

C/S technologies are revolutionizing customer service and supply chain management systems, in particular. Suppliers that can manage their distribution chain use C/S systems to obtain better marketing information, reduced inventory costs and faster payments.

5. Remote Users

Apple calls the interaction between a desktop computer and a mobile device, such as a Newton PDA (Personal Digital Assistant), a client/client/server architecture. An emerging opportunity for C/S software vendors is to support mobile professionals using PDAs, intelligent cellular phones and portable PCs. They need server software that may reside on a public or private network.

Telecommuters are another category of remote user that need C/S system support, particularly for communications and information retrieval applications. Oracle has recently announced support for Apple's Newton and other PDAs.

C
Application Trends

The recent C/S revolution has focused on data processing systems. These incorporate corporate records, data dictionaries and databases. Other applications, which may also include a database, that are moving to a C/S architecture include the following:

- Messaging—electronic mail and workflow

- Document imaging

- Telephony

- Video

- Systems management

- Mathematical computation—engineering analysis

- Geographical Information Systems (GIS)

These functions may be combined with databases. Software that implements several functions may reside on a single server. The section below gives some insight into trends in each application segment.

1. Messaging

Lotus Notes is the leading messaging-based C/S product. Oracle has recently announced its intention to compete. In particular, messaging-based applications like Lotus Notes and Microsoft Mail are integrated with data stored in traditional databases. Gupta also has a development arrangement with Lotus to combine C/S development tools with Notes. Novell's MHS (which will be incorporated in Netware 4.0), Microsoft's MAPI and Apple's AOCE are messaging foundations that will be used to carry information between databases. The trend is toward incorporating fundamental message transport and security functions into the operating environment so messaging security is merged with network security.

2. Document Imaging

Document imaging systems such as those from FileNet, Compulink, Recognition International (Plexus Software division) and Wang use C/S architectures to route documents using workflow software. ASK/Ingres has recently acquired software from Wang to offer a document imaging solution. Unlike most of the C/S market, this is a segment where turnkey systems are prevalent. Systems that combine mainframe databases with imaging and microfilm systems are available from companies like Bell & Howell, Recognition International and Xerox.

3. Telephony

Traditionally PBXs have had a closed architecture—phones from different PBX manufacturers are not interchangeable. For several years Macintosh users have been able to access Northern Telecom's Meridian PBX features such as telephone dialing and electronic mail from a Macintosh computer. In the early 1980s, several attempts at using terminals to access PBXs via computers were made, the most notable terminal being Northern Telecom's Displayphone. These efforts failed to gain widespread market acceptance because telephone users are not prepared to pay more than a few hundred dollars for advanced telephony. The situation is different today because users have PCs and PBXs can be attached to standard computers.

PC LANs threaten the PBX. Phones are already integrated with desktop workstations, as an increasing number of users have headsets attached to PCs. The PBX is becoming one of many LAN servers. However, before LANs replace PBXs they must be 100% reliable. Fault-tolerant programming of applications must be undertaken by system integrators and software vendors. In the short term, when reliability is still an issue, the following software developments will foster the growth of telephony applications in a C/S environment:

- Novell's AppWare—Visual development platform for networking and telecommunications applications

- Microsoft's Windows At Work—Software for connecting faxes, copiers and phones to office equipment

AT&T is working with Novell on PBX software. Directory services will be provided using C/S technology.

4. Video

Silicon Graphics, Sun Microsystems and Apple Computer offer built-in desktop video for their workstations. Desktop video is going to be a major C/S application with products starting to be installed widely in 1995. Video servers for media publishers, telephone companies and cable TV service providers present another opportunity.

5. Systems Management

C/S system security is supported by authentication and authorization and naming services on servers. Software may physically reside on the same computer as an application, or it may be on separate servers, depending on the system size. Authentication ensures that the client is genuine when it connects to the network. Authorization ensures that clients access appropriate information, usually using password schemes. Naming services provide a directory of users and resources with permissions and passwords.

System administration deals with back-up, recovery and security. A server that can support automatic back-up and switch the system to a back-up site in the event of disaster is required for mission-critical C/S applications. In addition to systems management, network management and capacity planning are areas where C/S systems are increasingly deployed.

6. Mathematical Computation—Engineering Analysis

This is the "compute server" market. It started with engineering workstations linked to Cray supercomputers, then Convex entered the market. Now Silicon Graphics, Sun Digital, IBM and Hewlett-Packard support for quantitative problem solving in manufacturing, financial services, transportation and education.

Already, games like SimCity 2000 are used for corporate simulations at major Fortune 500 companies. As business modeling becomes more widespread, C/S simulation systems will be increasingly needed to integrate corporate data with visual models.

7. Geographic Information Systems

Geographic Information System (GIS) software typically runs on workstation systems, with Intergraph a leading platform. Applications are found in government, oil & gas exploration, engineering and transportation. The main C/S trends are toward integrating GIS data into object-oriented databases that can interact with corporate data to make visually appealing decision support systems. Geographic systems that use local as opposed to data collected over a wide area, will become popular. For example, hospitals will use object-oriented databases to display floor plans, patient data and medical images.

D
Platform Trends

1. Mainframes and Minicomputers

A trend back toward the mainframe has been observed in the last year, after an initial euphoria for C/S computing. Companies are organizing their data on older mainframes and minicomputers before moving to newer platforms. Once companies realize the cost of migrating applications, they find they lack the capital to move their legacy applications off the mainframe.

Lower cost CMOS microprocessor-based mainframes will reduce the cost of mainframe hardware and are expected to replace aging machines starting this year. However, the cost of operations management and complex software architecture mean that many users will continue to migrate their data to relational databases on UNIX and Windows NT servers. On a going-forward-basis, organizations will capture data on newer systems until older computers can be retired.

2. UNIX

UNIX clients are used for C/S implementations where multitasking is critical, for example, in customer service applications. Sun is seeing success in the telecommunications and utility industries. Other major UNIX applications are engineering, high-end publishing, network management and visualization.

UNIX workstations have typically led the industry in technical innovation and companies like Silicon Graphics are promoting

3-D visualization and desktop videoconferencing on their Indy client workstations. Another innovative vendor, NeXT, with a major cellular phone company, is planning to install UNIX-based customer service workstations that connect to cellular phone service providers in electronics stores. IBM, who already supports PowerPC workstations running AIX, can be expected to roll-out its Workplace OS with a Mach-kernel that will run Macintosh, UNIX and OS/2 applications. A major trend in UNIX client workstations is lower prices and more hardware support for multimedia and desktop videoconferencing.

UNIX servers are likely to continue to serve the high-end to midrange of the C/S market. Pyramid is an example of a UNIX server vendor that is strengthening its appeal to the downsizing market by labeling its Nile family of servers as fault-resilient. This overcomes the objection some IS managers have to UNIX machines—that of not having mainframe reliability and performance.

Since Novell purchased the UNIX development organization from AT&T, the rationale for OSF (i.e., to develop an alternative version of UNIX, OSF 1.0) has been weakened. Hardware manufacturers are taking control of their own environment—with X/Open publishing standards. OSF has a role, albeit diminished, to provide technology leadership and coordination. In reality, OSF's current software developments like DCE and X-Windows/Motif will complete their current releases, then hardware manufacturers, like IBM, Sun, Digital and HP, will undertake their own enhancements.

Since its buyout of UNIX rights for more than $80 million, SunSoft can compete with Novell as a supplier of UNIX code. Novell risks losing OEM and shrink-wrapped UnixWare customers. However, Novell is more likely to succeed as a supplier of UNIX than SunSoft because it has established customer relationships and does not have a competing hardware organization. SunSoft can be expected to pitch Solaris against Windows NT to the system integration and user market. Windows NT will compete with UNIX initially in the LAN upgrade markets. It will become a serious threat to undifferentiated UNIX platforms in the 1996-2000 timeframe. See Exhibit V-4 for UNIX trends.

EXHIBIT V-4

UNIX Trends

- Lower priced client workstations, less than $5,000
- Client/server applications—customer service, engineering, visualization, high-end publishing, network management
- 3-D graphics, multimedia and desktop videoconferencing
- Hardware vendors will control future operating system enhancements—Novell at risk

3. Apple Macintosh

Macintosh clients are found in business services organizations, education and publishing departments, as well as in marketing. Macintosh clients are increasingly teamed with UNIX servers. The Oracle database is supported on clients and servers and more vendors are following UniFace and offering application development tools across Windows, UNIX and Macintosh platforms. The major trend in Macintosh clients is the ability to run with other operating systems.

Apple bundles SoftWindows from Insignia Solutions, thereby enabling Windows software to run on Macintoshes. Also Sun and Hewlett-Packard expect to support Apple software running on their workstations. A major reason for this move is that Apple Macintosh PowerBook notebook computers are often found in the workstation environments. Also this enables low-priced Macintosh applications to run on UNIX, where applications software is usually more expensive.

The most significant Macintosh development is the PowerPC. This processor will enable Apple to have powerful servers, that will provide easily maintainable networks. According to Apple, networks based on the Macintosh frequently cost 50% less to maintain than Windows networks. Exhibit V-5 denotes Macintosh trends.

EXHIBIT V-5

Apple Macintosh Trends

- PowerPC will lead to major upgrades
- Ventures with IBM—Taligent for object-oriented frameworks, PowerOpen (also with Motorola) for PowerPC
- 3-D graphics, multimedia and desktop videoconferencing
- Licensing MacOS to run on other platforms
- More powerful servers

4. Windows and OS/2

Windows NT can be expected to take the midrange server market, particularly for customers who are upgrading from a Windows LAN. Compared with UNIX, Windows NT has limited interoperability with other platforms. It will take time before Windows NT is the server platform of choice for communications. Windows for palmtops, Windows 4.0 and Cairo (object-oriented Windows) will provide scalability.

Windows 3.1 clients are under-powered for many C/S applications as they do not support pre-emptive multitasking. Many will be upgraded to Chicago (Windows 4.0). Meanwhile for many users, OS/2 with its ability to support Windows, DOS and OS/2 is a superior solution. OS/2 which suffered a rocky start, is starting to be recognized as technically superior to MS-Windows. The recent spurt in OS/2 sales could be stunted when Microsoft offers Windows 4.0. The PowerPC is likely to become a major platform for OS/2. For OS/2 to continue growing, IBM will need to make it dramatically better than Windows 4.0, Windows NT and Cairo. Exhibit V-6 reflects Windows and OS/2 trends.

EXHIBIT V-6

Windows and OS/2 Trends

- Object-oriented Windows with OLE 2.0 and MAPI for object exchange and messaging
- Windows in the fax, phone and copier
- Pentium and Power PC will lead to major upgrades
- OS/2 is increasing in popularity because it is more robust than Windows and supports pre-emptive multitasking
- Mach-kernel from IBM will support Workplace OS, based on OS/2's Workplace shell

5. Platform Combinations

In observing C/S system development, different platform combinations are starting to emerge:

- Windows PCs linked to mainframes and minicomputers, via intermediate servers

- Windows PCs linked to Novell Netware servers

- Apple Macintoshes linked to UNIX servers

- OS/2 clients linked to diverse servers, particularly those from IBM

Whereas Windows is the *de facto* standard for desktop computing, Apple has had difficulty in the office systems environment. Many users want to run any application on any machine. They do not want to have to buy an Apple Macintosh and a PC. There is a trend to running an operating system kernel that can support multiple operating systems, known as multiple personalities. C/S applications based on Windows could, for example, link into a Macintosh desktop application like Excel, using Apple's forthcoming OpenDoc architecture or Microsoft's OLE.

Exhibit V-8 shows how the client platform can be expected to evolve. At the highest level, applications will be upgraded to include common object components that are shared with other packages. The operating system will become more object-oriented

and multiple operating systems will run on a single computer. The processor will be a RISC processor, offering significant compute power. This will enable animations and simulations to be integrated with C/S applications. See Exhibit V-7.

EXHIBIT V-7

Platform Migration Example

Applications Access Data	Cross-Platform Applications Improved Data Access	Cross-Platform Applications Process Objects and Data
Windows		Workplace OS, Taligent Frameworks, Windows
DOS	OS/2 or Chicago (Windows 4)	OS/2 Mach Kernel
386/486	Pentium (586)	683 or Power PC
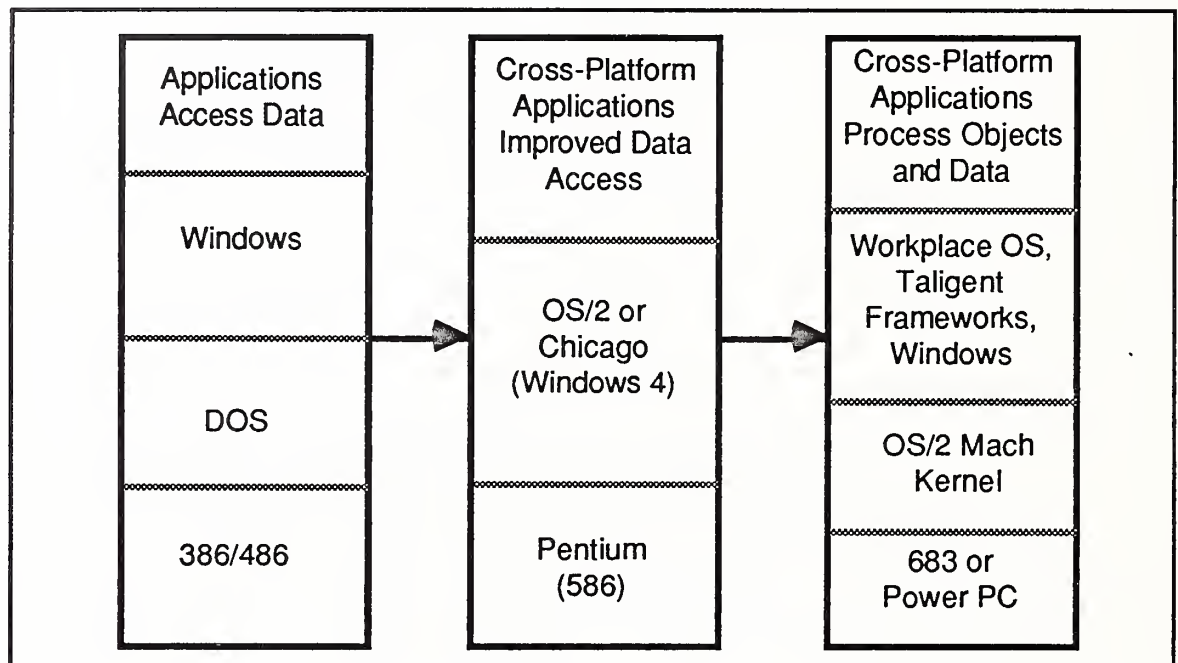
D
Technology Trends

The most important technology developments affecting C/S computing are:

- Microprocessor performance

- Object-oriented development

- Distributed databases

1. Microprocessor Performance

In 1993, the clock-speed of fast microprocessors reached that of fast mainframe processors for the first time, at a much lower cost. This fundamental development means that PCs and workstations are not only ahead on price/performance, but now servers based on workstation technology can match the performance of a mainframe. However, disk access speeds have

not kept up with these developments, hence, the need for intelligent storage management software that can cache data efficiently. Since memory prices are falling, large memories will be used. To address this memory, 64-bit addressing will be required. Currently OSF 1.0., Digital's UNIX operating system, supports 64-bit addressing. IBM, Silicon Graphics and Sun can also be expected to support 64-bit operating systems in the 1994-1995 timeframe. Fundamental hardware architecture developments are shown in Exhibit V-8.

EXHIBIT V-8

Fundamental Hardware Trends

Component	Trend	Frequency
Memory (DRAM)	4 Times Larger	Every 3 Years
Processors	3–4 Times Faster	Every 3 Years
Disk Capacity	2 Times Larger	Every 3 Years
Disk Performance	1.3 Times Faster	Every 10 Years

Source: Computer Architecture, a Quantitative Approach, D.A. Patterson and J. L. Hennessy, ISBN 1-55880-069-8, 1990

The above table indicates that the bottlenecks are in disk performance. The demand for RAID disk arrays will therefore continue. Client workstation storage on large SCSI drives will improve performance as systems become more distributed. In object-oriented C/S systems, pointers to objects, rather than objects, can be moved across networks. I/O bottlenecks will then be reduced.

2. Object-oriented Development

Distinction is drawn between pure object-oriented languages like SmallTalk and languages that support class-hierarchies like C++. Object-oriented tools for C/S computing have been developed in both languages, as well as in Objective C, particularly on the NeXT platform. The main effects of object-oriented programming on C/S computing is that the programmer can browse through high-level software components that resemble familiar business objects.

Some organizations are retraining COBOL programmers with success to use ParcPlace's VisualWorks SmallTalk development environment. Other organizations are using MicroSpace Focus

environment. Other organizations are using MicroSpace Focus
COBOL to move COBOL from the mainframe to the PC. The
COBOL code is then tagged as a Windows Dynamic Linked
Library (DLL) that can be linked into a SmallTalk or Windows
application development environment.

Another major object thrust is in distributed objects, using the
Object Management Group's CORBA standards. Companies are
aligning themselves as to which object standards to support.
First, Sun and NeXT are building NeXT's communication objects
into Sun's Distributed Object Environment. Hewlett-Packard and
Digital are also supporting NeXT. Secondly, IBM, Apple and
Hewlett-Packard have invested in Taligent, that is building object-
oriented frameworks. Finally, Microsoft is promoting OLE 2.0, as
its standard for linking objects from one application to another. .

These three contenders for distributed object processing could be
upset by a messaging vendor like Lotus who is linking
applications, like Notes and cc:Mail, with FX technology.
Microsoft will also use its messaging architecture, MAPI, to
transmit objects between applications. It is also worth noting that
HyperDesk, one of the first vendors of CORBA-compliant
distributed software has recently halved its staff. In comparing
the object request broker approach versus the messaging
approach, messaging is more likely to be used when the systems
being connected are separated and network communications are
best handled in a store-and-forward network.

A cultural change that affects organizations moving to object-
oriented programming is that the development process tends to be
cyclical. Programming groups used to first writing
requirements, then specifications then coding will find that object-
oriented programmers design and build at the same time. The
process is shown in Exhibit V-9.

EXHIBIT V-9

Object-oriented C/S System Design Process
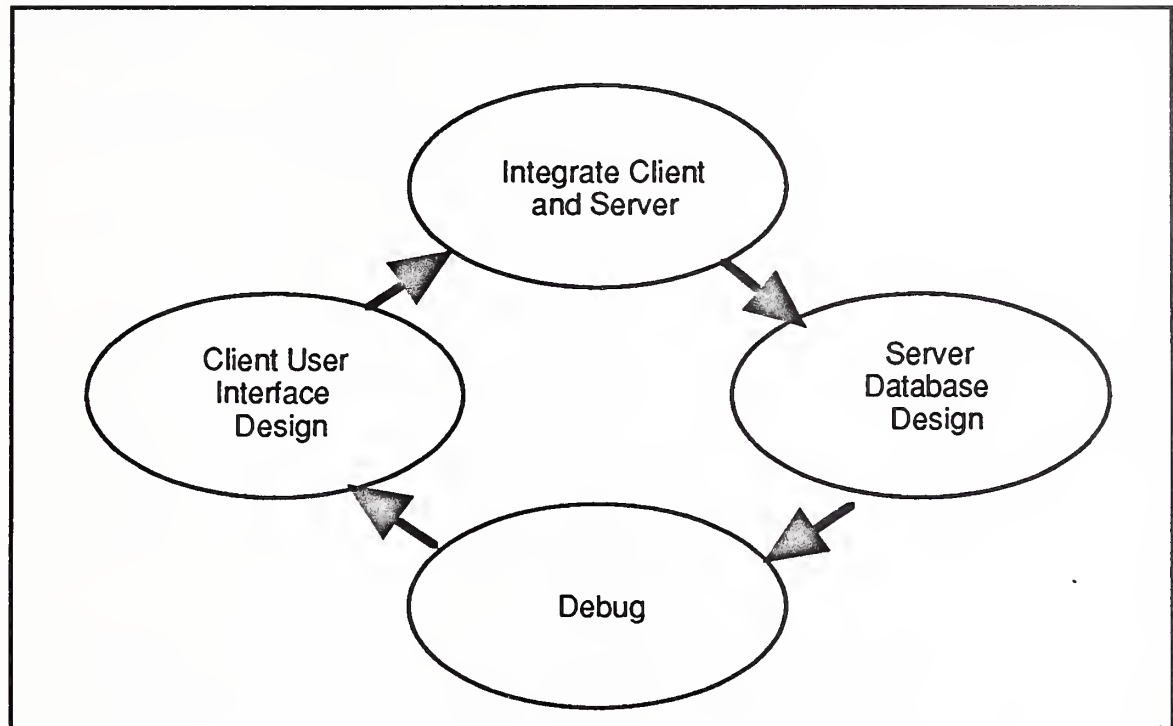
Object-oriented support in CASE systems, such as Cadre's Teamwork, is another major trend related to object-oriented programming. Hybrid relational and object-oriented databases, like Montage, are emerging. The object-oriented vendors, like Object Design are moving toward more standard database functionality as relational vendors add object-oriented support.

Another trend that goes with object-oriented design is the growth of applets. Applets are small applications that can be used as building blocks for the applications. For example, today computers have a system clock that is accessed by a wide range of programs. In the future, a complete personal schedule or diary may be accessible. Communications will be another area for applets. Apple's PowerTalk architecture is marketed with the Macintosh System 7 Pro operating system. This has a common mail box that fax, on-line database, electronic mail and other applications can use. There is an emerging market for applets that can integrate into C/S applications.

3. Distributed Databases

Various industry estimates suggest that 65% to 85% of corporate data is stored not in databases, but in flat files or record systems

like IBM's VSAM or Informix's c-ISAM. Sybase, in particular, has positioned its database as a way to integrate this data into a C/S system. Conversion tools for migrating data from mainframes to newer architectures are still quite primitive, they focus on converting data dictionaries and screen definitions, but generally cannot convert entire systems. Hence, migrating data away from mainframes will take several years.

Stored procedures and triggers are two leading features of C/S databases. Stored procedures enable a client application development tool to write a procedure that is then stored on the server until it is required. Triggers are rules that alert the application when an event occurs. For example, in an inventory database, a trigger could send a message to an operator console when inventory was almost depleted.

Databases are expected to support more automatic processing with rules and business knowledge encoded in systems. Agents are small programs that can move between databases and carry out transactions. They are used widely in network management and some customer service applications. They are also widely used in information retrieval. Greater use of agents to automate routing, delivery and reporting of information can be expected.

Data integrity is a key issue as C/S systems evolve. Data that is in a server may not be synchronized with data in a client application. As C/S tools develop, more are supporting data integrity between databases. Data may be replicated at different sites for performance and reliability. Sybase supports replication.

Another way of ensuring integrity is to use a two-phase commit. In this type of transaction it is not posted until all databases agree that it has been carried out. If any database disagrees then the transaction is rolled back. Two-phase commit is widely supported, but requires all the databases being updated to be on-line at the time of the commit transaction. More database tools to support integrity can be expected.

VI

Industries

This section provides a brief overview of industry segments. It starts by examining the penetration of C/S architectures, based on INPUT's user survey. It then briefly describes key applications and issues related to C/S in each industry. Details for specific vertical markets can be found in INPUT's vertical market reports from the C/S program and the Market Analysis Program, as well as select reports from Electronic Commerce, Business Integration and Outsourcing Programs.

A
Industry Segments

1. Penetration of C/S Applications

In the user survey, respondents were asked if they were migrating to C/S. Of these, 1,838 are coded by industry. The percentage migrating to C/S by industry is shown in Exhibit VI-1.

2. Budget Growth Rates for C/S Applications

In the user survey, respondents were asked how much they expected their budget for applications software to grow annually over the next two years. The average growth rates for those indicating a migration to C/S are compared with the growth rates for non-C/S applications in Exhibit VI-2.

VI-2

Percentage of Respondents Migrating to C/S by Industry

DS3

Discrete Manufacturing — 35
Process Manufacturing — 14
Banking — 13
Utilities — 27
Business Services — 8
Health Services — 53
Retail Trade — 14
Wholesale Trade — 50
Telecommunicatons — 50
Insurance — 30
Transportation — 33
Education — 27
State & Local Government — 18
Misc. Industries — 11

0   10   20   30   40   50   60

Percentage of Respondents
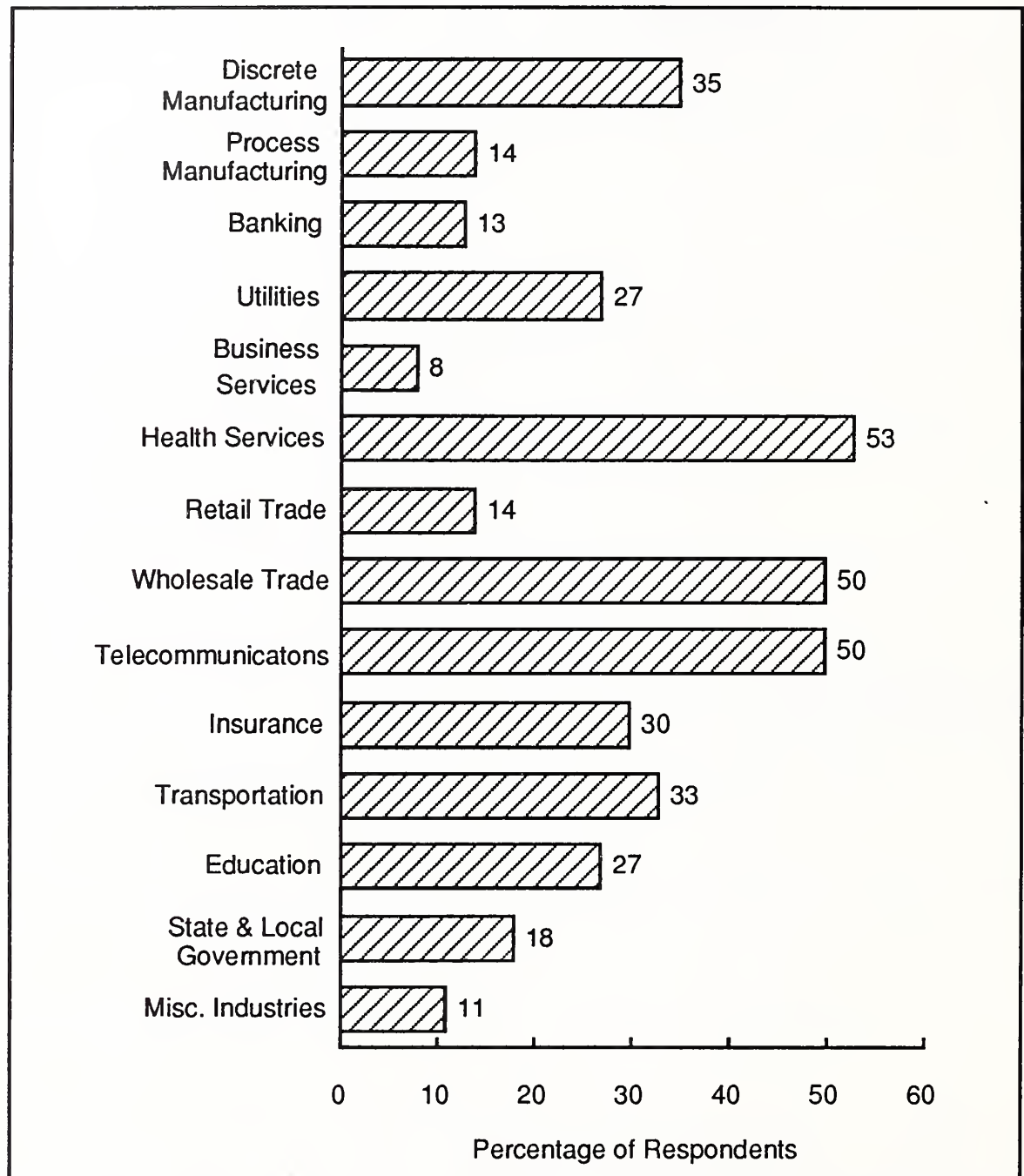
1,838 Respondents   *Source: INPUT User Survey, 1993*

EXHIBIT VI-2

Applications Budget Growth Rate
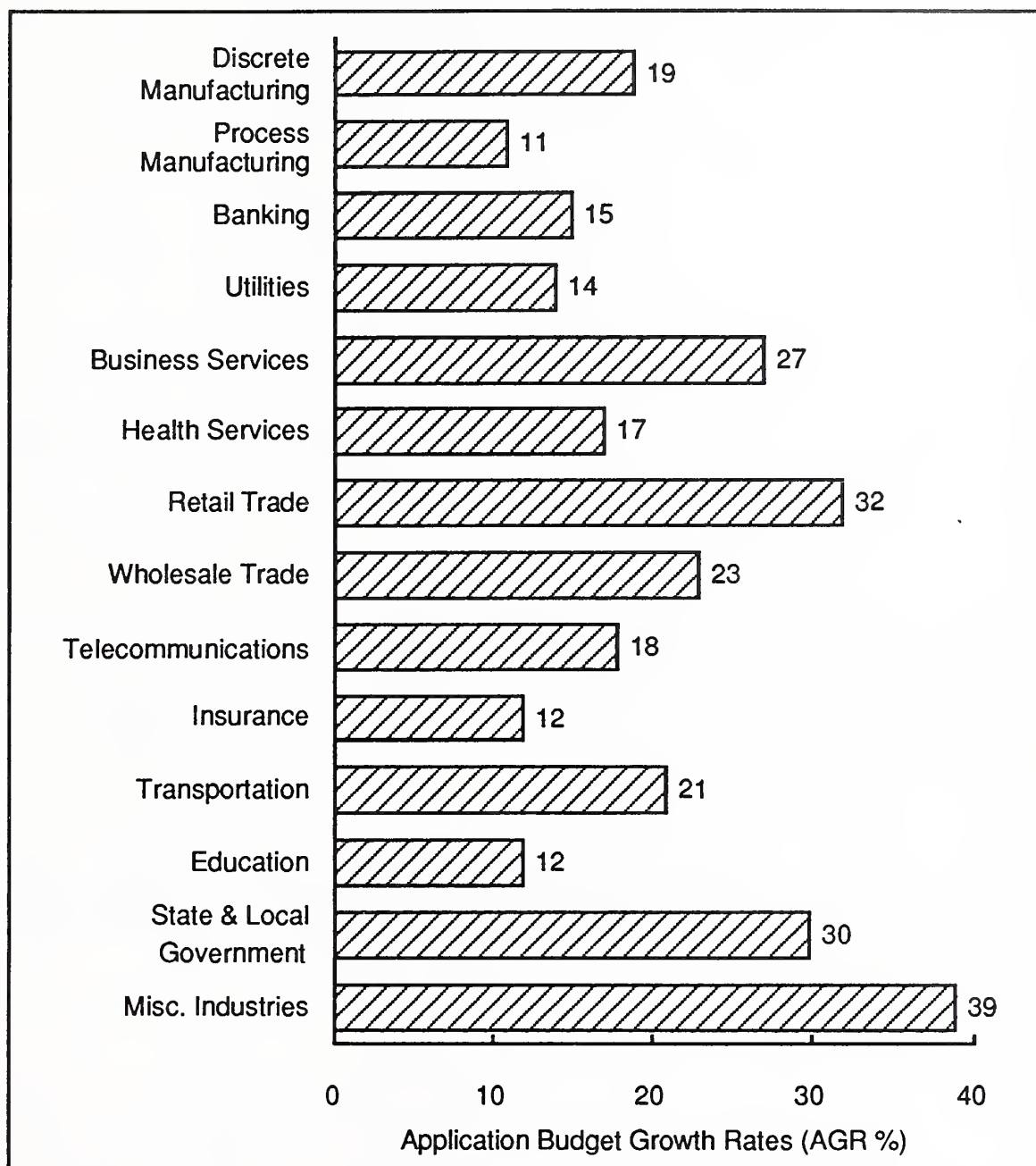
1,838 Respondents   Source: INPUT User Survey, 1993

B
Industry Issues

1. Banking and Finance

The banking market has been slower to adopt C/S technologies than some of the other market segments because of the need for security. Also IBM is very strong in the banking industry and some banks are waiting for OS/2 and Workplace OS to mature.

An exception to this is in the image processing area, where image servers can be linked with existing databases. There are two main image processing areas in banks, transaction-oriented image processing for checks, deposit slips and payment slips and document-oriented imaging for loan applications, customer forms and investment records.

In the financial services area, systems for analyzing financial markets and trading systems are two areas for C/S implementation. NeXT, Sun and Hewlett-Packard are especially strong in these areas. An open issue is whether Sun and Hewlett-Packard will support NeXT's development environment long term, or whether they will support it as a transitional strategy to migrate these users to other standards. The NeXT development environment can be used to rapidly design new applications as markets and financial instruments change. NeXT needs to succeed in expanding its presence in financial markets so that it can compete successfully with Microsoft and Taligent in the object-oriented operating system platform wars. According to INPUT's user survey, brokerage applications budgets are growing at 23% and financial services applications at 18%.

The advent of computer networks enabled organizations like Visa and MasterCard to offer credit card services. The elusive home banking market may become a reality through C/S networks that link consumers to their banks via TV.

2. Business Services

A key element of the business services market is the mobile professional. There are excellent opportunities for software that can connect accountants, management consultants and advertising services to their customers. In the business services market non-C/S applications were split approximately one third on mainframes, one third on minicomputers and one third on workstation or PC LANs. This is an unusually high percentage of minicomputers compared with other industries. Many of these will need replacing, presenting an opportunity for vendors that can offer LAN-based C/S applications. There is a need for integrated C/S packages for sales lead management, time-billing systems and accounting systems that can be managed with minimal effort.

Computer programming service companies represent another challenge. As C/S software development depends more on component-based development—software that links programming development environments becomes critical. An example of a product that can be used to link programming development teams with messaging for tracking trouble reports, is Hewlett-Packard's SoftBench. As C/S systems include more components and complex data repositories the need for C/S scalable development environments will increase.

This is another area where C/S systems have not had a high degree of penetration to date. In this market, there is a relatively high proportion of Apple Macintosh networks that rely on local data stored in applications like Excel, 4th Dimension and FileMaker. These applications can be upgraded with Oracle servers on A/UX.

C/S networks will offer many opportunities for new business services. For example, professional computing services vendors can offer remote system administration of lights-out data centers using C/S networks.

3. Education

Education is a market that traditionally has developed its own software, but it is very well connected through the Internet. Hence, software sharing is common in this market. C/S vendors of application development tools need to seed computer science, business schools and engineering departments with systems to ensure that graduating students are capable of using their software. This will be particularly important for developers of application frameworks, as programmers will be reluctant to learn new environments if they are familiar with one they have learned about in school. The success of C as a programming language is due, in part, to its early use in leading universities and colleges. Educational institutions rely on mainframes for more than half of their non-C/S applications. This is an unusually high percentage. Vendors can offer C/S solutions, that integrate with mainframe student record systems and financial systems, to educational institutions.

4. Federal Government

In an attempt to become more efficient, the federal government will implement C/S systems where productivity gains can be proven. Software suppliers can partner with government system integrators like Computer Sciences Corporation, Martin Marietta, EDS, Litton Federal Systems and GTE Vantage Solutions, to name a few. For example, Litton Federal Systems has a multibillion dollar program to modernize the IRS.

A major trend in the commercial C/S market is the sharing of risk and reward. This trend can be expected to become more prevalent in the federal government. INPUT's federal government program covers this segment in detail.

5. Health Services

Health care organizations are interested in improving the quality of medical decisions. Matching treatment with a patient's medical condition is a key challenge, especially as medical records may be scattered and hard to retrieve. A major application for C/S in the health services market is integrating patient records, in particular within a community where a patient may visit multiple doctors. The health services industry is migrating rapidly to C/S as a way to integrate multiple platforms, found in the typical hospital or health care management organization. Interpractice Systems (San Francisco, CA) the joint-venture of EDS and Harvard Community Health Plan has developed a C/S system for patient records that can be entered at multiple stations in a hospital. This reflects a trend away from paper-based medical forms, which some medical professionals resist losing when they move to C/S computer-based patient record systems.

Integrating bedside data is another intense area of C/S activity. Using visualization for diagnosis and surgery is another area where multimedia C/S systems will be used extensively over the next five years.

6. Insurance

In the insurance market C/S computing is revolutionizing the way in which premiums are quoted. Underwriters can access multiple databases and compare quotes for different policies instantly. Claims processing is another area where C/S systems

that are integrated with workflow and image management are deployed.

7. Manufacturing

The main opportunity for manufacturers is to manage their supply chain using C/S computing. Manufacturers are also getting products to market faster using modeling, simulation and visualization to test product concepts on computers before they are built. For example, car manufacturers can use Silicon Graphics workstations to access massive databases and develop car models using 3-D graphics thereby reducing development time.

Over the next five years, C/S systems will be used to improve customer service, order according to demand, build custom orders and reduce time to market new products.

8. Retail Trade

Quick response, perpetual inventory and point-of-sale systems are all areas where retailers are using C/S systems to order faster, capture consumer buying patterns and manage inventory more efficiently.

9. State and Local Government

C/S systems in state and local governments are allowing welfare recipients to obtain benefit information instantly instead of waiting two weeks. State and local government has a heavy concentration of mainframes, and integrating or migrating custom applications on mainframes is a major challenge for C/S system integrators.

10. Telecommunications

Billing and customer service systems are two areas of intense C/S activity in the telecommunications industry. The long term opportunity is for multimedia services. This will require massive upgrades in infrastructure that will present an opportunity for C/S systems integrators and software providers. Network management is an area where object-oriented C/S systems are being developed.

C/S systems integrators and software providers. Network management is an area where object-oriented C/S systems are being developed.

11. Transportation

United Parcel Service, DHL and Federal Express depend on C/S technology for efficient operations. United Parcel Service has made effective use of C/S technology for capturing data entered from tablet computers. Federal Express can track packages using bar codes and a distributed system. For non-C/S applications, application budgets are growing at 6% in the transportation industry, compared with 22% for C/S applications. The non-C/S applications tend to be equally divided between mainframes and PC LANs.

12. Utilities

As in telephone companies, billing and customer service systems present opportunities for C/S vendors. Also supply chain management and workflow tracking are key areas for C/S systems. In utilities, applications budgets for C/S systems are growing at 14%, compared with 9% for non-C/S systems.

13. Wholesale Trade

Applications budgets for inventory systems are growing on average 16%. As in the retail and manufacturing industries, systems that connect customers and suppliers are the key growth area.

C
Comparison of Growth and Market Size

The table on the following page describes the market segment opportunities by taking each segment and defining by growth and size of C/S applications market. High-growth means applications budgets growing at least 15%. "Large market" means the market for C/S vertical market applications software in 1993 was at least $200 million.

Vertical Market Comparison Based on Growth and Size

	Small Market (Less than $200 Million)	Large Market (More than $200 Million)
High Growth	Wholesale Trade State & Local Government	Retail Trade Telecommunications Health Services Transportation Discrete Manufacturing
Low Growth	Banking & Finance Insurance Education Utilities Process Manufacturing	Federal Government

(Blank)

VII

Market Forecasts

This chapter explains how the C/S market is measured.
Forecasts are made for the 1993–1998 timeframe for systems and
applications software in the U.S.—services and hardware
forecasts are excluded.

A
Measuring the Client/Server Market

For this forecast, the sales of software used to build a C/S
application are measured. This is done by examining the
proportion of new systems that are likely to be implemented as C/S
systems for each platform. The value of software purchased for
use in C/S systems is then estimated.

B
Systems Software

- Software license upgrades are included in revenues, unless
  the upgrade is included with professional services. In this
  case, it is included under professional services and not a part
  of this forecast. For example, if Microsoft offers a $99 upgrade
  for Access it is included here, but if a mainframe software
  vendor provides a contract at 15% of the purchase price for
  fixing bugs and technical support, then it is excluded.

- Service revenues of vendors with a significant consulting
  business, like Oracle are omitted.

- INPUT usually breaks forecasts down by platform:
  mainframe, minicomputer, workstation/PC. This has only
  been done for the systems software overall forecasts, because
  C/S applications software may run on multiple platforms.

- It is assumed that mainframe systems software growth rate
  will decline after 1994, even when the mainframes are used in
  C/S systems. This revenue will move to minicomputer priced
  machines, in the $15,000 to $350,000 range—hence, the growth
  in minicomputer revenues. Selling prices of UNIX-based SMP
  machines average around $150,000 for mainframe
  performance. The assumption is that there will be some
  machines sold with peripherals that are more than $350,000.
  However, in general, the mainframe market based on IBM,
  Amdahl and Unisys mainframes will decline sharply. This is
  particularly true in the area of application development tools
  where most programmers program on a PC or workstation.

Exhibit VII-1 shows the systems software forecast for 1993 to 1998
by platform. It represents the value of software sold for use in a
C/S system in user prices.

EXHIBIT VII-1

Systems Software for C/S Systems Forecast by Platform
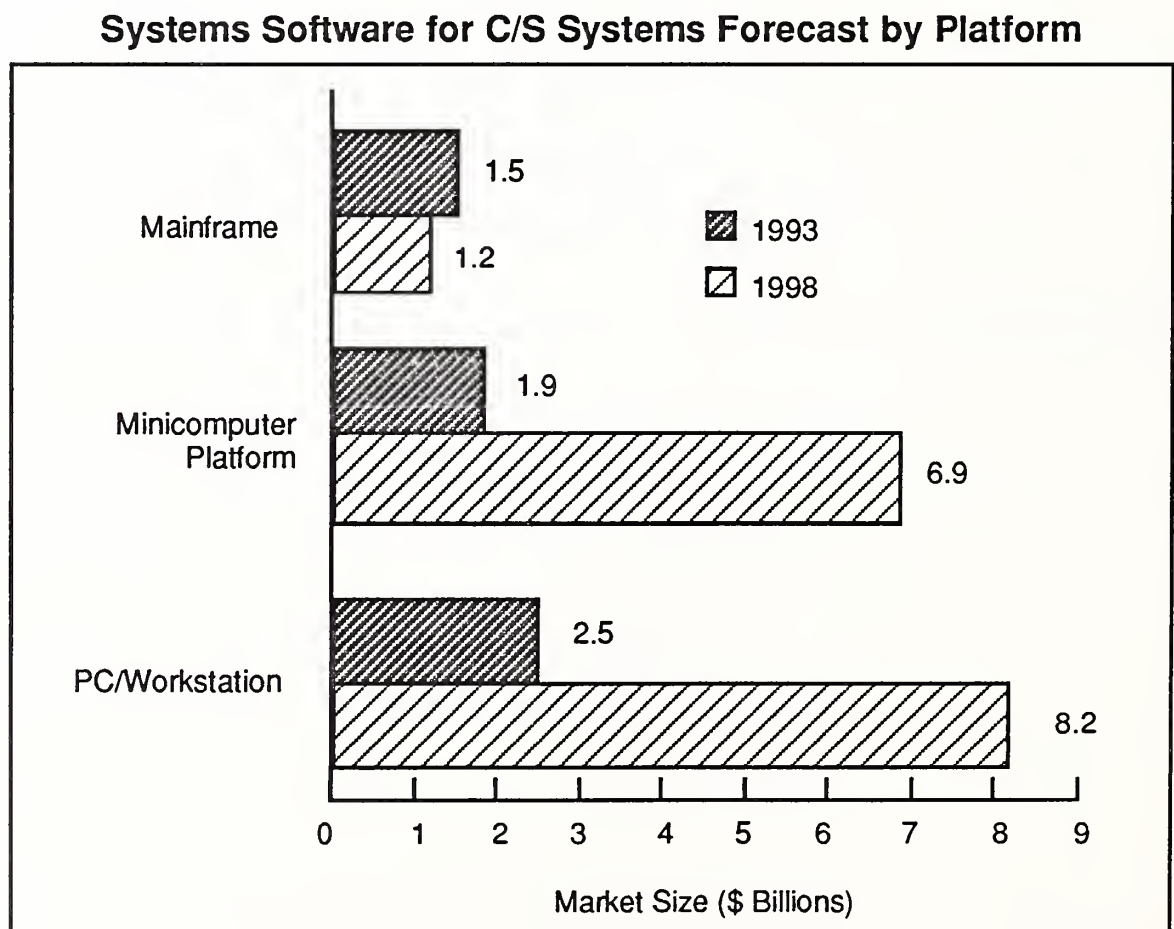
The total C/S systems software market is estimated at $5.9 billion
in 1993, growing to $16.3 billion in 1998, with a CAGR of 22%.

CAGR rates by platform from 1993 through 1998 are shown in Exhibit VII-2.

CAGRs by Platform
for C/S Systems Software

Platform	CAGR (%)
Mainframe	-4
Minicomputer	30
PC/Workstation	27

Source: INPUT

The forecasts for C/S development tools are broken down into three categories as shown in Exhibit VII-3.

Market Size
for C/S Systems Software

Market Size ($ Billions)
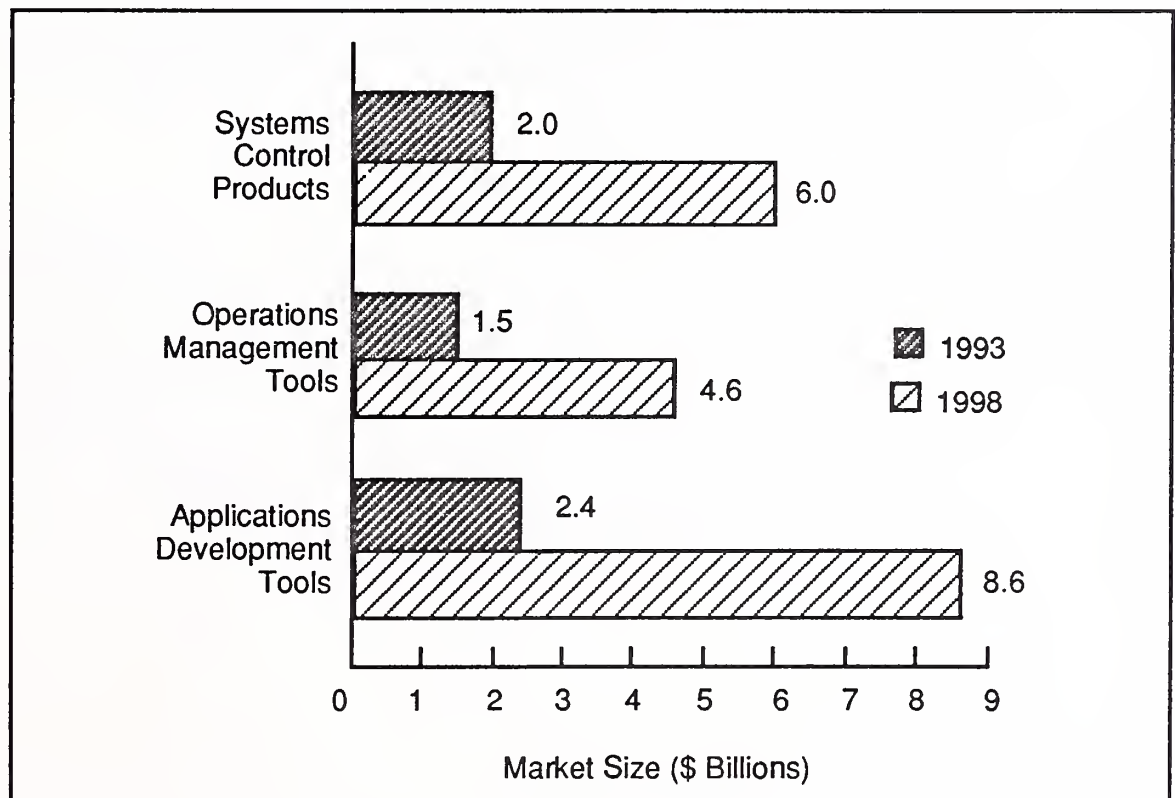
The CAGR for systems software is shown in Exhibit VII-4.

EXHIBIT VII-4

CAGRs by Category
for C/S Systems Software

Software Category	CAGR (%)
Systems Control	20
Operations Management	21
Applications Development Tools (Including Databases)	24

Source: INPUT

C
Applications Software

1. Assumptions

This section forecasts applications software and is divided into vertical and cross-industry applications. It does not include systems software or software developed on a custom basis by value-added resellers and system integrators.

2. Vertical Applications

Forecasts for C/S vertical applications are made by industry segment. This represents the sales for the U.S. market of software that is industry specific and sold for installation in C/S systems. Exhibit VII-5 and Exhibit VII-6 show the market breakdown by industry segment for 1993 and 1998 respectively. The CAGR from 1993 to 1998 for C/S vertical market applications is estimated at 43%.

EXHIBIT VII-5

C/S Vertical Market Applications by Industry Group, 1993

Miscellaneous 4%

Banking, Insurance, Business Services 12%

Retail, Wholesale Trade & Transportation 22%

Telecommunications & Utilities 14%

Education & Government 18%

Manufacturing 19%

Health Services 11%
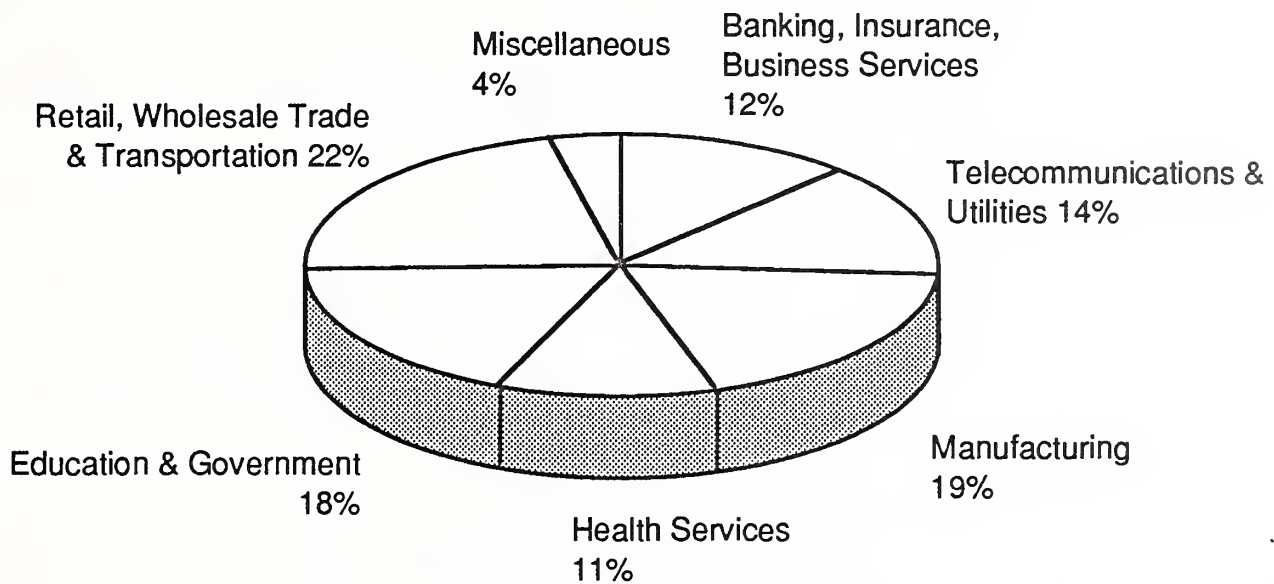
Source: INPUT

EXHIBIT VII-6

C/S Vertical Market Applications by Industry, 1998

Miscellaneous 6%

Banking, Insurance, Business Services 8%

Retail, Wholesale Trade & Transportation 15%

Education & Government 12%

Telecommunications & Utilities 30%

Health Services 8%

Manufacturing 21%
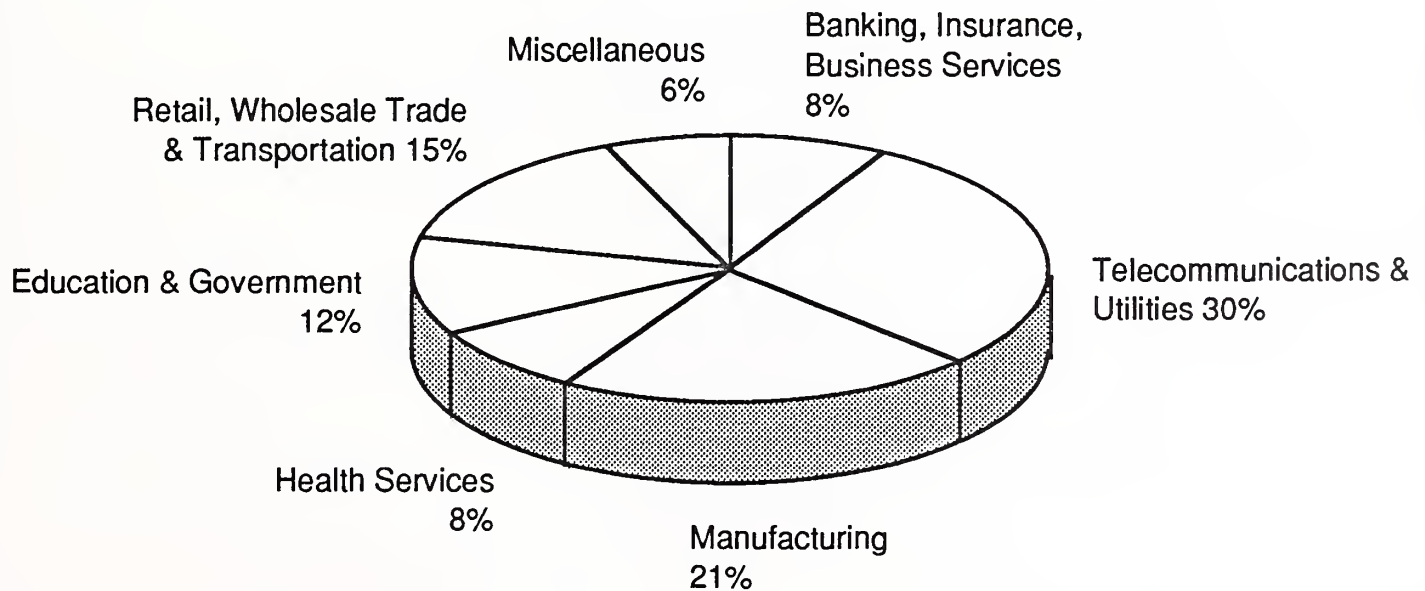
Source: INPUT

The size of the market for C/S vertical applications and CAGRs are shown in Exhibits VII-7 and VII-8.

EXHIBIT VII-7

C/S Vertical Application Software Market, 1993-1998

Market Size for Software for C/S Applications ($M)

Category	1993	1998
Utilities	150	1,063
Misc. Industries	100	1,049
Wholesale Trade	163	839
Banking and Finance	154	594
Insurance	149	528
Retail Trade	200	498
Education	111	392
State & Local Government	150	373
Business Services	47	289
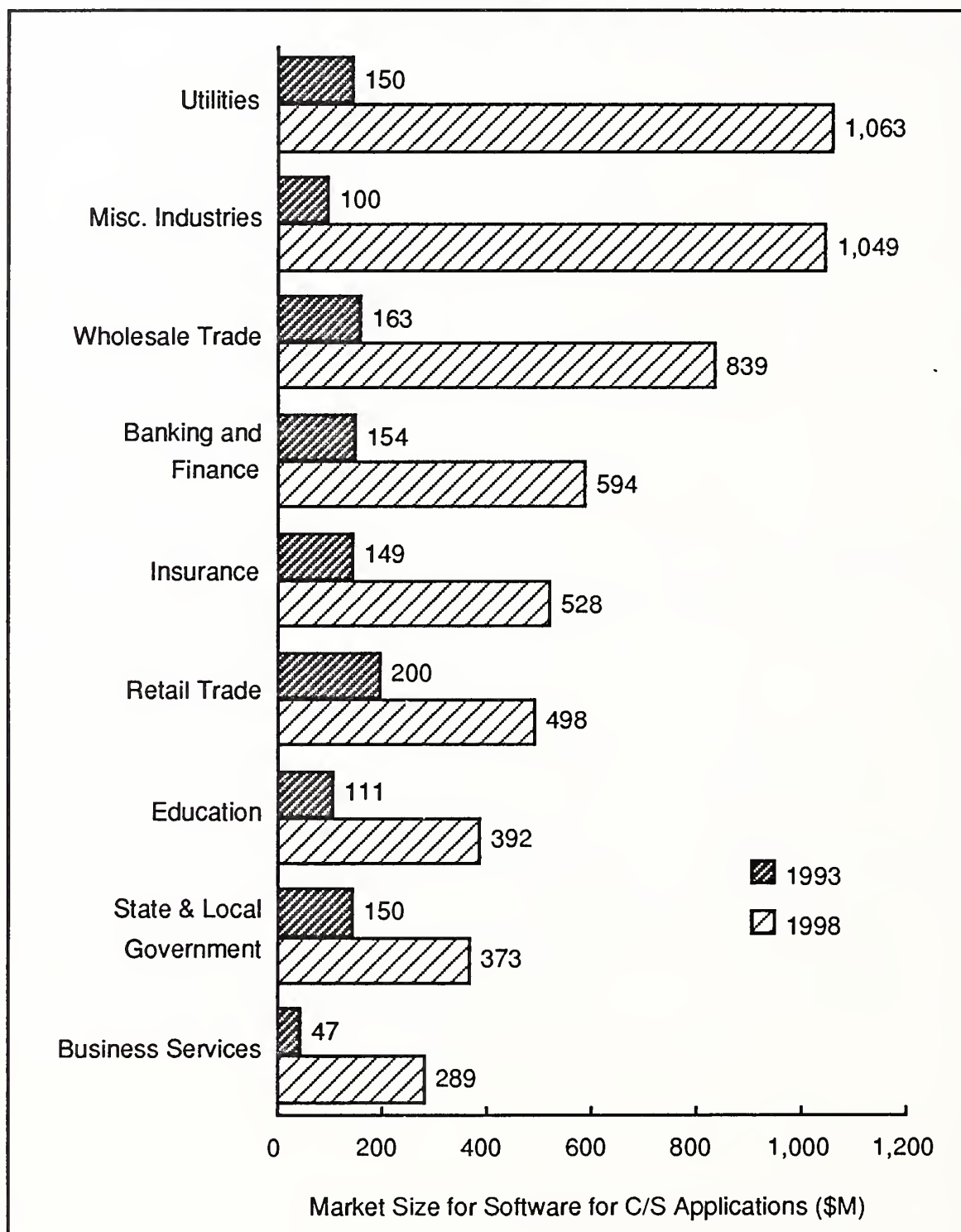
Note: The scale changes for the market size.

EXHIBIT VII-7 (Cont.)

C/S Vertical Application Software Market, 1993-1998
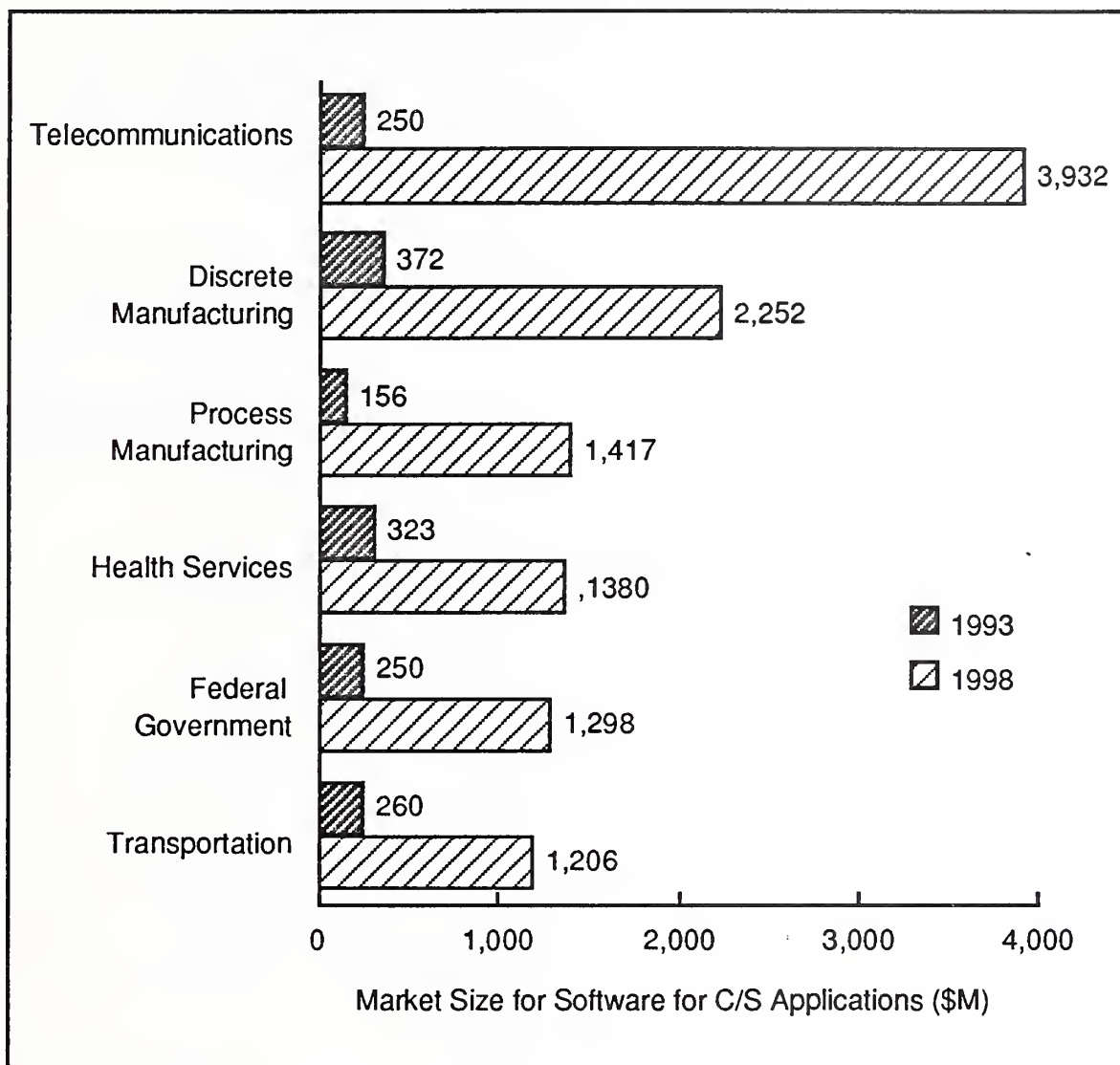
Customer service and decision support systems are high growth applications in any vertical market for C/S implementation.

3. Cross-industry Applications

In the survey, 242 out of 903 respondents (27%) described cross-industry applications that are migrating to C/S. The number and percentage of respondents moving to C/S in each category is shown in Exhibits VII-8 and VII-9.

Number of Respondents Migrating to C/S by Cross-industry Application
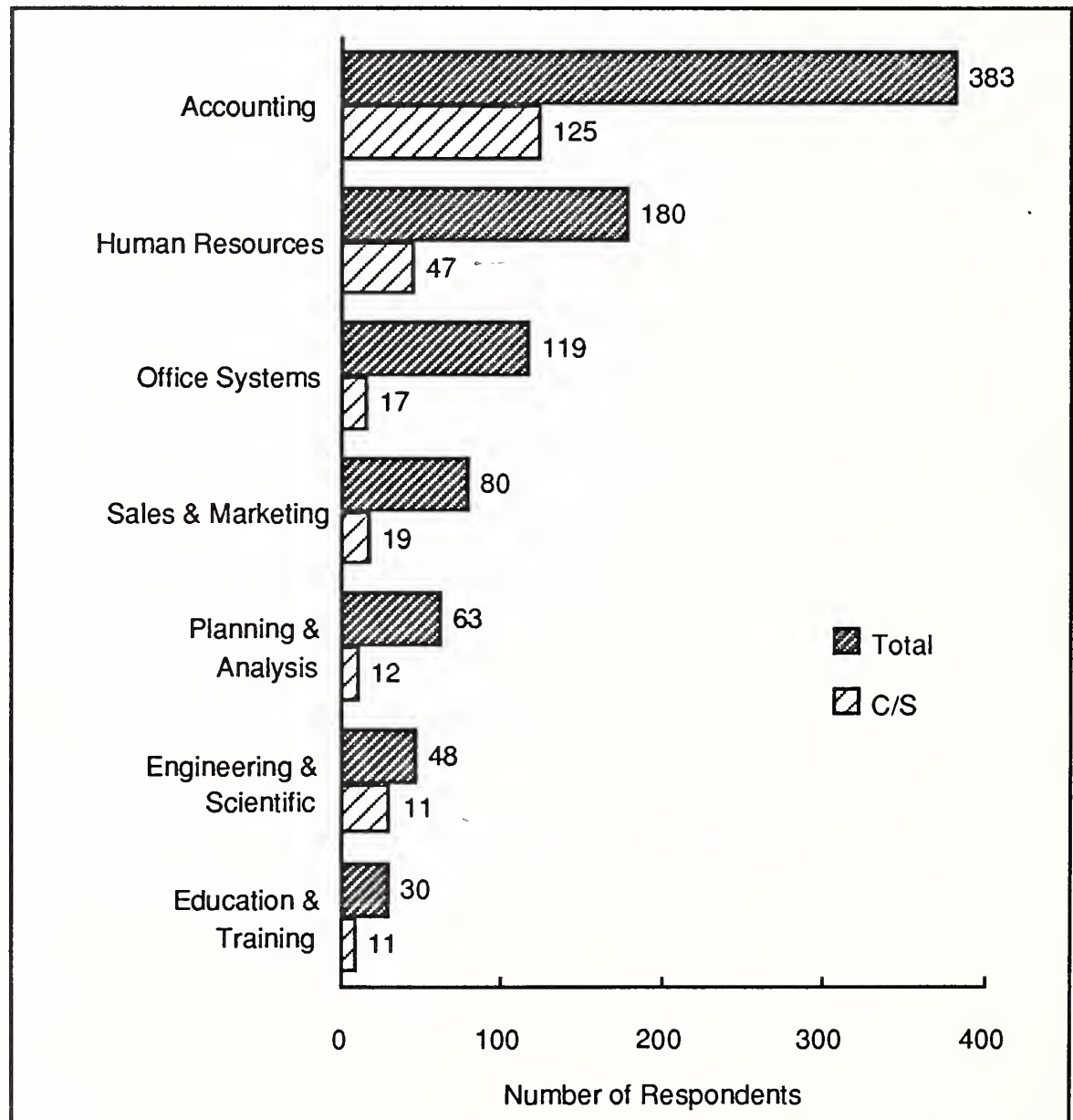
EXHIBIT VII-9

Percentage of Respondents Migrating to C/S by Cross-industry Application

VII-9

Application	Percentage
Education & Training	37
Accounting	33
Human Resources	26
Sales & Marketing	24
Engineering & Scientific	23
Planning & Analysis	19
Office Systems	14

Percentage of Respondents Migrating to C/S
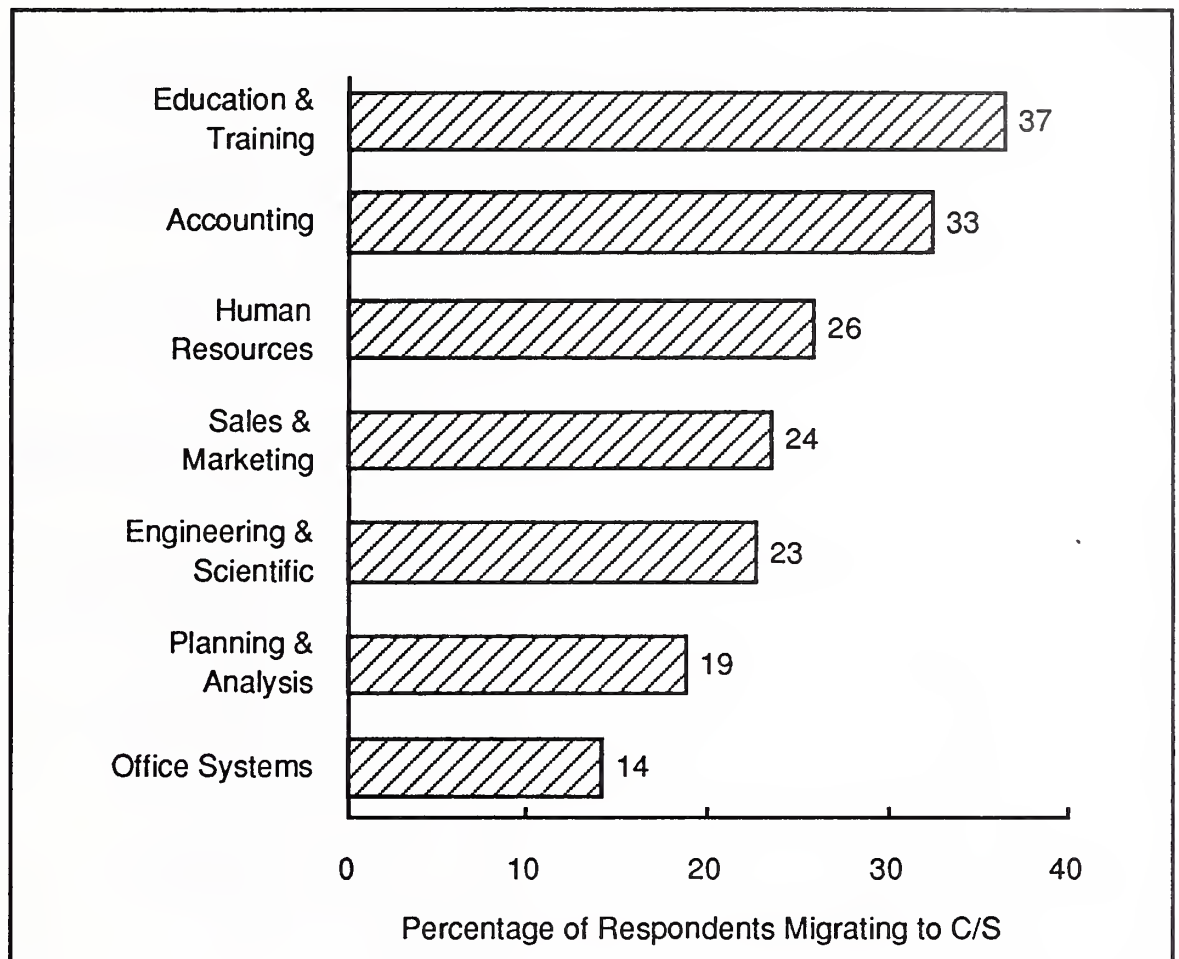
The growth rates for C/S and non-C/S cross-industry applications budgets are compared in Exhibit VII-10.

EXHIBIT VII-10

Budget Growth Rates for Cross-industry Applications

Office Systems: C/S 22, Non-C/S 9
Human Resources: C/S 22, Non-C/S 13
Accounting: C/S 18, Non-C/S 11
Planning & Analysis: C/S 17, Non-C/S 11
Engineering & Scientific: C/S 15, Non-C/S 9
Education & Training: C/S 14, Non-C/S 11
Sales & Marketing: C/S 5, Non-C/S 7

Legend: C/S, Non-C/S

Budget Growth Rates (AGR %)
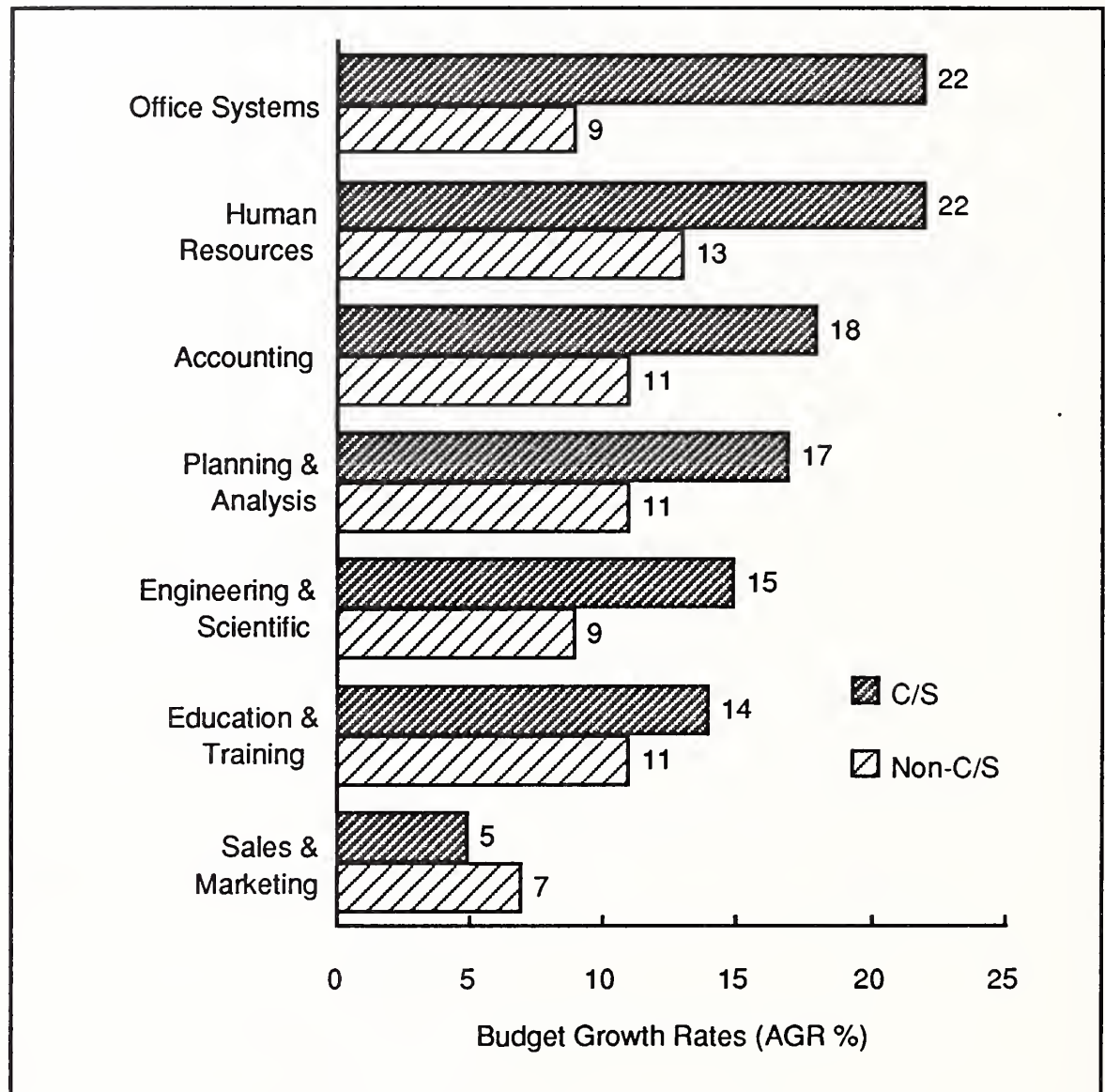
The cross-industry applications forecast is shown in Exhibit VII-11.

EXHIBIT VII-11

Cross-industry Applications Forecast

Application	1993	1998
Accounting	1,179	3,721
Human Resources	728	2,321
Office Systems	478	932
Planning & Analysis	459	1,098
Sales & Marketing	315	915
Engineering & Scientific	248	2,022
Education & Training	139	664

Market Size ($M)
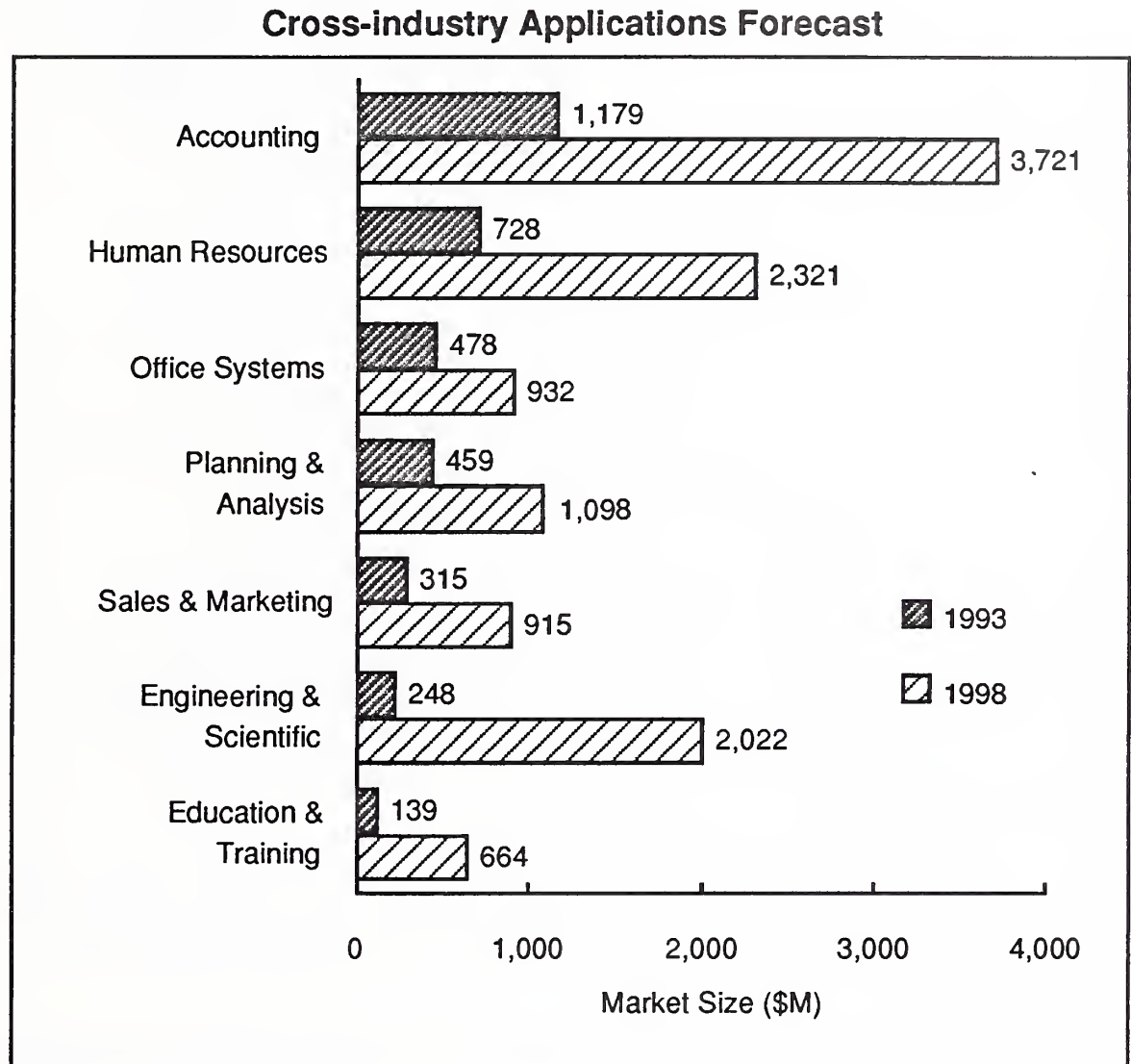
CAGRs from 1993 to 1998 for the cross-industry applications software market are shown in Exhibit VII-12. The high growth of the engineering and scientific market is explained by the greater integration of databases into that market. As computing power becomes more affordable, scientific and engineering applications will increasingly become C/S.

EXHIBIT VII-12

CAGR for Cross-industry Applications
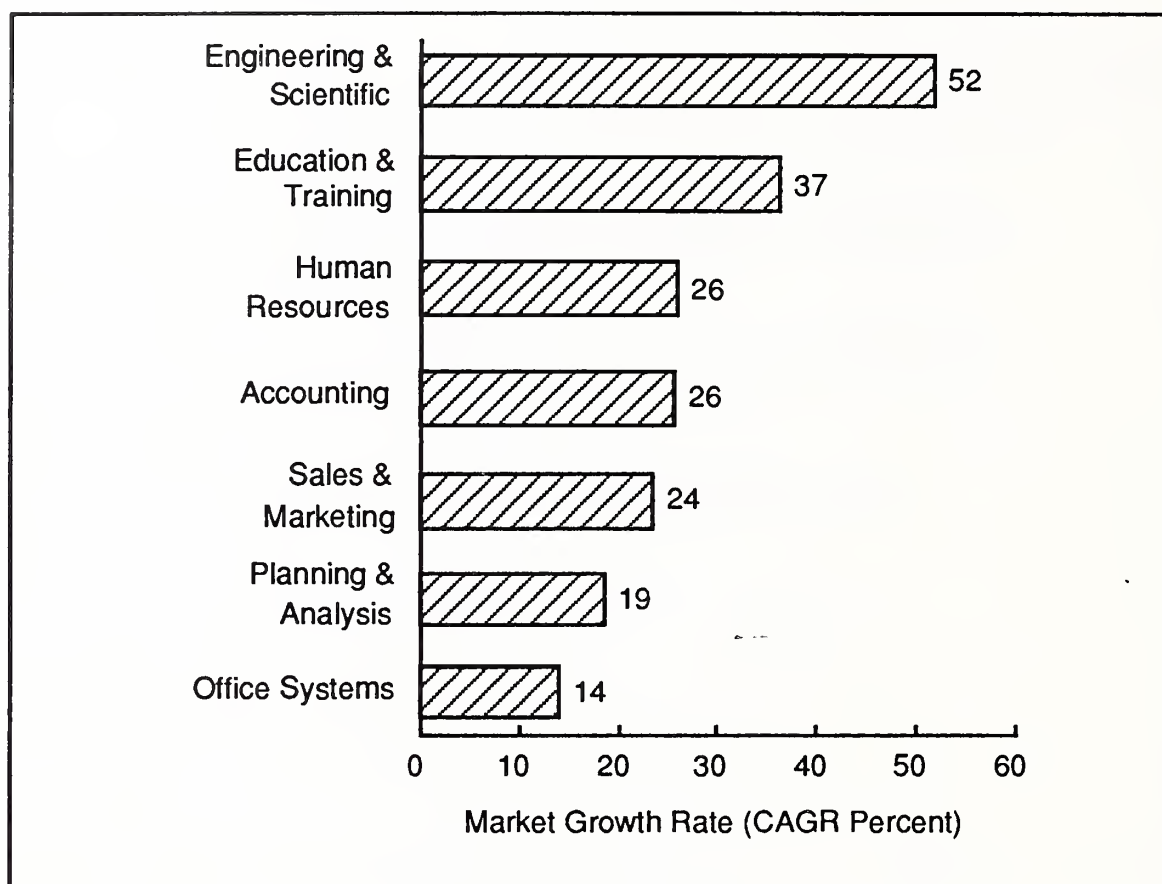
The total cross-industry applications forecast is shown in Exhibit VII-13. The cross-industry applications market CAGR is 21%, similar to the 22% CAGR for systems software.

EXHIBIT VII-13

Total C/S Cross-industry Applications Forecast
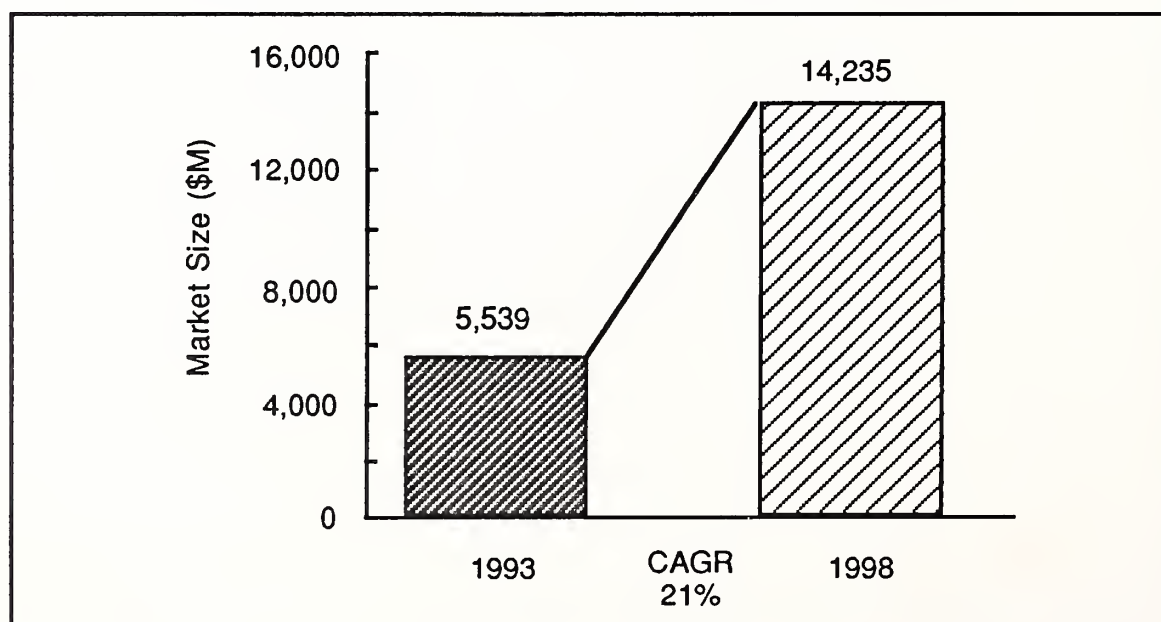
D
U.S. C/S Software Market Projections, 1993–1998

The total C/S market for systems and applications software is projected to grow from $14.3 billion in 1993 to $50.6 billion in 1998 with a CAGR of 29%.

The total C/S software forecast breaks down as shown in Exhibit VII-14.

EXHIBIT VII-14

C/S Software Market Forecast Broken Down by Category
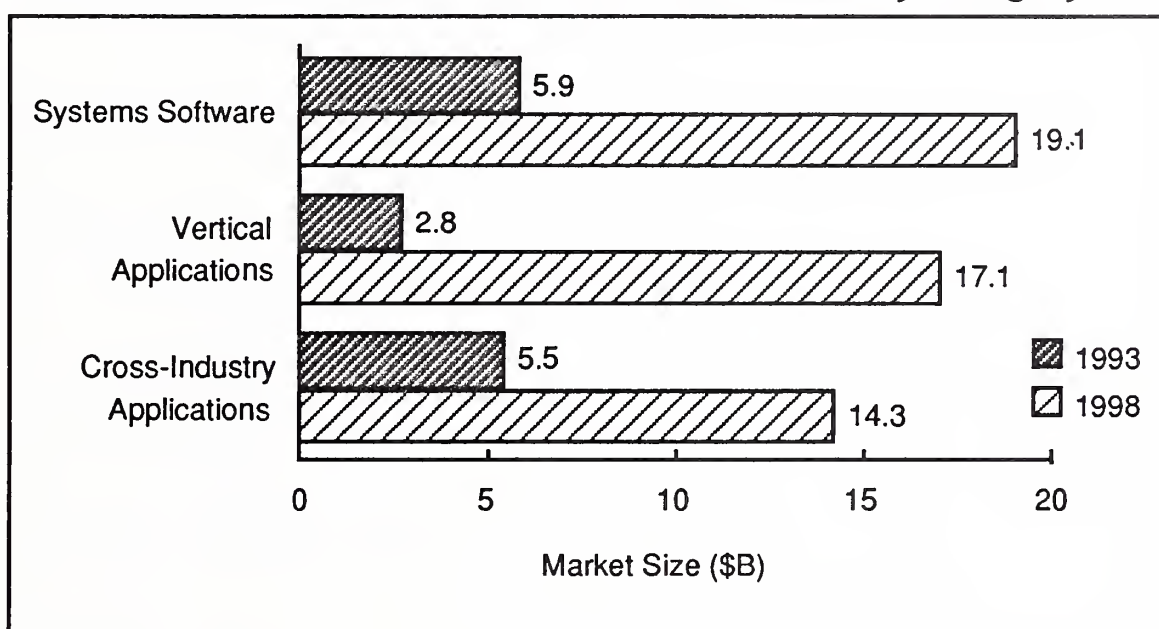
As can be seen, the greatest growth is in applications software, which has a CAGR of 43%. The largest market is for systems software, a significant component of which is database and software development tools.

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VIII

Opportunity Assessment

This section presents strengths and weaknesses of C/S computing, opportunities and risks.

A
Strengths and Weaknesses of C/S Computing

1. Strengths

The strengths of C/S computing are:

- Modularity

- User choice

- Team-oriented development

- Ability to integrate jobs

- Access to legacy data

a. Modularity

Components in a C/S system can be purchased separately. This enables systems to be built incrementally, changed gradually and scaled to grow with the enterprise. Flexibility to add workstations, interconnect databases and replace servers means that organizations can be merged, divested and acquired without having to rebuild an entire system.

b. User choice

In a C/S system, users can often format their own reports on PCs and workstations, thereby customizing their system without the assistance of a central IS group. Users can choose platforms, software and application features to meet their needs. Usually

C/S systems reduce user training costs, once they learn how windowing systems work.

c. Team-oriented Development

The modular nature of C/S computing means that a large system can be developed with small teams programming different parts of the system simultaneously. C/S development tools are typically integrated into a workbench, like HP's SoftBench that has messaging communications to support remote teams of programmers.

d. Ability to Integrate Jobs

Before there were C/S systems, accessing multiple databases meant having a separate video display terminal for each database. Each terminal required an operator. With C/S systems, a single operator can access the same databases via windows on a PC or workstation, thereby reducing headcount.

e. Access to Legacy Data

Legacy systems have been built over several years and many companies are reluctant to redesign their mainframe applications to run on more cost-effective hardware.

2. Weaknesses

The main weaknesses perceived in C/S systems are:

- Complexity of systems integration

- Security

- Systems management

C/S systems are more difficult to integrate, hence the expansion of the C/S integration market. Mapping business requirements on to system designs is complex. However, tools are starting to simplify development.

Servers, whether they be mainframe or UNIX-based, can be made secure given enough planning and system utilities. PCs can be physically locked. The real threats are viruses, network security and gateways to external networks. Security is not a technical

concern, it is a management issue. New security procedures need to be established.

Monitoring a C/S system that connects with external networks is a major challenge. Systems management, including systems administration, network management, backup and recovery all present challenges to IS managers.

B
Opportunities

The opportunities for vendors are to:

- Develop integrated application solutions, especially for smaller businesses.

- Market object libraries, especially to simplify networking.

- Develop tools to manage C/S networks, especially for security. Tools that integrate network, database and/or operating system security with DCE to simplify system administration are desirable.

C
Risks

The main risks are:

- C/S budgets are underestimated. INPUT research shows that these budgets are growing faster and are larger than non-C/S budgets for comparable applications. Organizations need to budget for support and testing as well as software and hardware. This risk can be mitigated by clearly understanding the cost of each project phase in terms of personnel, software, hardware, testing, support and integration. Vendors may supply sample cost models.

- Management does not understand the development cycle and cancels a client/server project prematurely. C/S systems require advance planning and results are not always immediate. Developers need to ensure that a plan is developed that shows progress towards a complete system in well-defined phases.

- Systems administration requirements are not well understood. This risk can be reduced by ensuring that support staff in user organizations are organized to help MIS system administrators.

- Users become over-dependent on database and operating system vendors. Users want simplified procurement and a few key vendor relationships. Open systems standards mean that users can choose hardware. In developing C/S architectures users have to decide to what extent they want to rely on such vendors as Microsoft, Oracle or Sybase and what alternatives they can use.

- Networks may be configured with insufficient testing, making them unreliable and insecure. To reduce this risk, high quality network management personnel, both internal and external to an organization are needed.

- Users are either not trained or unwilling to take the initiative to learn new systems. IS departments can provide initial training, but the full power of C/S systems can only be exploited by the users. Time must be provided for users to suggest system improvements and enhancements. Intense training will usually be provided when a system is deployed, however many users neglect ongoing training. Users with flexible systems, such as those found in decision support environments, need to have significant time, for example one hour a day, set aside in the initial phases of system deployment to learn how to use the system optimally.

A
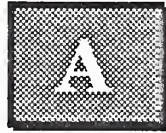
Definition of Terms

INPUT's Definition and Terms book gives standard definitions.
This appendix provides specific definitions used in this report.

Agent	A program that can undertake a task without user intervention. It is typically a script. Examples of agents are shell scripts and SNMP agents for network management. In this report it will typically mean a short program that goes into a network to perform a task. An example is an agent that a client sends into a network to query multiple databases and return with the result of the query.
API	Application Programming Interface. Specifications that define how a programmer writes software that interacts with an application.
APPC/APPN	IBM protocols for peer-to-peer networking.
Applet	A small application like a calendar or visual editor that can be integrated in a wide range of applications.
Application	Software that is ready to be used to perform a function. Examples are network management, accounting, system administration, planning and scheduling.

Application framework	Software that can be readily customized and enhanced to develop an application. It is generally used to apply to object-oriented software such as from Taligent or NeXT, that provides a foundation from which applications may be built.
Architecture	A design for a system or software product.
Broadcast	A system that uses broadcasting is designed so that the same data or information is sent to multiple clients.
Business process	A sequence of business functions, such as ordering, shipping and invoicing.
C/S	Client/server
Client	A computer that makes a request of a server. It is usually a PC or workstation. However, if server A requests information from server B then one could refer to A as a client for the particular request.
Client workstation	A workstation or PC that acts as a client.
Component	Refers to either system or software components. System components may include software, client workstations, servers, databases, operating systems and networking software. Software components include DLLs, objects, applets, databases, drivers and screen designs.
Cooperative processing	Cooperative processing is usually used to describe processing where application logic is distributed but data resides in a common location. Oracle markets its technology as cooperative processing.
Customer	One who buys a C/S system.

Development tool	Software used to create an application.
Distributed database	A database that appears to function as a single database, but runs on multiple machines. Data and/or processing may be distributed. In a fully distributed database, data and processing may be distributed.
Dumb Terminals	Video display terminals or PCs with terminal emulation boards that receive and display data, but do not process it.
Information Service	A service like Prodigy, CompuServe or America Online that provides information over a data network.
Interoperable	Two systems are interoperable if they can send data or otherwise communicate with each other.
Messaging	A general term that refers to the transfer of data from one place to another. At a low-level it may mean message passing—a technical term. At a high level it includes electronic mail, workflow and document tracking applications. It may also include telephony applications where speech is treated as data in a network.
Mission-critical	Used to describe an application without which a business cannot function. Frequently, but not always, a mission-critical application processes transactions. This means it has to be reliable and perform well.

Objects	Objects are software components. Depending on the development environment they have different properties. Microsoft objects are typically written in C++ and lack some of the dynamic features of SmallTalk objects. In an object-oriented language like SmallTalk, objects have certain properties that enable them to be maintained easily and added to programs after they have been installed.
Purchaser	Same as customer, one who purchases a C/S system.
Real-time	Traditionally real-time has been applied to operating systems with time-critical constraints. In C/S computing, real-time may have less stringent time constraints— the appearance to the user is that an event happens immediately.
Server	May refer to a physical computer that provides services to PCs and workstations in a C/S network. It may also refer to a logical server, where the software provides services for a particular function. For example, a communications server and file server may service two logical functions, communications and file management, on the same computer.
Store-and-forward	Refers to a system in which data is sent from one place to another and is stored temporarily at an end node or intermediate location. Store-and-forward technology is used in electronic mail systems.

Transaction monitor	Traditional transaction monitors such as IBM's CICS were used to improve the performance of mainframe computers for high-volume short transactions like those found in airline reservation systems and on-line banking applications. Newer transaction monitors like Novell's Tuxedo and Transarc's Encina provide more functionality and enable a client workstation to access multiple databases transparently.
Transparent access	This term is used to describe access to a database when some of the details are hidden from the application programmer. The underlying network architecture or differences between databases may be hidden.
User	One who uses a C/S system for business functions such as accounting, data entry or electronic mail.
Workflow	Software that tracks items such as documents, trouble reports, messages.

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B
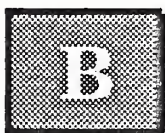
Vendor Names and Addresses

This section provides names and addresses of vendors mentioned in the report.

EXHIBIT B-1

Vendor Names and Addresses

| Company	Notes
Apple Computer 20525 Mariani Avenue Cupertino, CA 95014 Tel: 408-996-1010 Fax: 408-996-0275	The PowerPC microprocessor will make Apple Macintosh computers more powerful for C/S applications. Powerful PC servers will support C/S installations. Apple Macintosh operating system will run on IBM, Sun, HP and other operating systems. Expect Apple to become a significant C/S player over the next five years, because of initiatives with Oracle and MIS managers using Apple's VITAL C/S architecture. With OpenDoc distributed objects and multimedia support Apple will be a player in innovative C/S systems, particularly in desktop videoconferencing and mobile communicator (Newton) client/client applications.
AT&T Global Information Systems (was NCR) 1700 S Patterson Blvd Dayton, OH 45479 Tel: 513-445-5000 Fax: 513-445-4184	Markets Top End transaction monitor used for large-scale applications, such as Delta Airlines reservation system and WalMart's merchandising systems.
Compuware Northwestern Highway, Fl 2 Farmington, MI 48334 Tel: 313-737-7300	Acquired Uniface, offers C/S system management tools and services to major corporations, particularly the auto industry.
Dynasty Technologies 500 Technology Drive Naperville, IL 60563 Tel: 708-355-8300 Fax: 708-355-9345	Developing an enterprise C/S application development system that generates C code.
Forté Software Harrison Street, Floor 15 Oakland, CA 94612 Tel: 510-834-1501	Developing a powerful C/S application development tool for enterprise applications. It is particularly useful for database applications that require active communication between users.

Company	Notes
Gupta Corporation 1060 Marsh Road Menlo Park, CA 94025 Tel: 415-321-9500 Fax: 415-321-5471	One of the first Windows GUI application development tool builders with SQL Windows.
Hewlett-Packard 19310 Pruneridge Avenue Cupertino, CA 95014 Tel: 408-447-4042 Fax: 408-447-5809	Leader in open systems computing. Several object-oriented initiatives for C/S computing—databases, Smalltalk, Taligent and NeXT support.
IBM Corporation 1 Old Orchard Rd Armonk, NY 10504 Tel: 914-765-1900 Fax: 914-765-4190	Promoting C/S computing as a major strategy. AIX will be the key open systems platform and an OS/2 operating system kernel will allow multiple operating systems to run on a PC or workstation. Major object initiatives with CORBA-compliant DSOM (Distributed Systems Object Management) together with Taligent's application frameworks will revolutionize programming, particularly in document-centric applications. This initiative will help integrate corporate data processing with office automation environments using C/S systems.
Lotus Development Corporation 55 Cambridge Parkway, Cambridge, MA 02142 Tel: 616-577-8500 Fax: 617-225-1213	Notes is a leader in C/S messaging. It is designed primarily as a document database that transfers documents between users. Gupta is working with Lotus to develop C/S development and report writing tools. Lotus is also integrating its SmartSuite products, having replaced cc:Mail in the suite with Lotus Approach, a relational database for small workgroups to rapidly analyze data.
Micro Decisionware 3035 Center Green Drive Boulder, CO 80301 Tel: 303-443-2706 Fax: 303-443- 2797	Acquired by Sybase for database gateway products.
Microsoft Corporation 1 Microsoft Way Redmond, WA 98052 Tel: 206-882-8080 Fax: 206-936-7329	Revolutionizing operating systems with Chicago (Windows 4.0) that will support greater interoperability between systems using OLE 2.0. Windows NT workstation and Windows NT Advanced Server will provide scalability for C/S platforms, particularly at the low-end. Microsoft Office (in particular Excel) will be increasingly used to access databases for office automation applications. Microsoft FoxPro has new C/S tools so that it can be used as a GUI development tool for SQL Server and other databases. SQL Server is a LAN-based database that Microsoft remarkets from Sybase. Microsoft's enterprise strategy includes TAPI (telephony interface), MAPI (messaging interface) and WOSA (Windows enterprise architecture).

Company	Notes
nCube 919 E. Hillsdale Blvd. Suite 200 Foster City, CA 94404 Tel: 415-593-9000 Fax: 415- 508-5408	Develops massively parallel processing servers suitable for data processing. Oracle has invested in the company and expects to enter the video and multimedia server market with the product.
Novell 122 E 1700 South Provo, UT 84606 Tel: 801-429-7000 Fax: 801-377-9353	Supplier of NetWare, UnixWare and AppWare platforms and tools. Plans to acquire Word Perfect.
Open Software Foundation (OSF) 11 Cambridge Center Cambridge, MA 02142 Tel: 617-621-7300 Fax: 617-621-8700	Currently marketing and developing DCE and Motif. DME distributed management environment is not widely accepted. Future is as a technology evaluator and standards coordinator for leading UNIX vendors supporting the COSE initiative. Long term future unclear.
Oracle Systems 500 Oracle Parkway Redwood City, CA 94065 Tel: 415-506-7000 Fax: 415-506-7151	With 40% of revenues from services, Oracle is expanding its consulting and applications business. It is also expected to be a major provider of multimedia server software.
ParcPlace Systems 999 E. Arques Avenue Sunnyvale, CA 94086 Tel: 408-481-9090 Fax: 408-481-9095	Leader in Smalltalk development tools with VisualWorks which is now used to develop C/S applications. Its portability enables it to run without recompilation across multiple hardware environments. Hewlett-Packard uses ParcPlace Smalltalk in its Distributed Smalltalk product.
PeopleSoft N California Blvd Walnut Creek, CA 94596 Tel: 510-946-9460 Fax: 510-946-9461	Developer of C/S accounting and human resources applications as well as development tools.
Powersoft Blanchard Rd Burlington, MA 01803 Tel: 617-229-2200 Fax: 617-272-9076	Leader in C/S GUI building tools with PowerBuilder. Recently acquired Canadian company Watcom for its languages and SQL database technology. Also sells PowerMaker and Power?? user programming tools.
RSA Data Security 100 Marine Parkway Redwood City, CA 94065 Tel: 415-595-8782 Fax: 415-595-1873	Leader in public key cryptography. Technology is incorporated in other products.

Company	Notes
Sybase 6475 Christie Avenue Emeryville, CA 94608 Tel: 510-596-3500 Fax: 510-658-9441	Leader in databases for C/S computing with Sybase System 10. Acquired Gain and Micro Decisionware recently to expand its product line.
Taligent 10201 N. De Anza Blvd, Cupertino, CA 95014-2233 Tel: 408-255-2525 Fax: 408-777-5082	Developing application frameworks initially for document-centric system development. IBM will be an early marketer of Taligent's technology that started as an operating system project code-named "Pink" in Apple.
Transarc The Gulf Tower 707 Grant Street Pittsburgh, PA 15219 Tel: 412-338-4400 Fax: 412-338-4404	Encina transaction monitor supports OSF's DCE. Transarc supplied technology for DCE to OSF. Transarc also markets the Andrew File System (AFS) developed at Carnegie-Mellon.
Uniface (recently acquired by Compuware) 1320 Harbor Bay Parkway Alameda, CA 94501 Tel: 510-748-6145 Fax: 510-748-6150	Recently merged with Compuware. Uniface has a sophisticated cross-platform, cross-database application development tool, Uniface. Its user interface is aging , as it primarily designed for text.

C
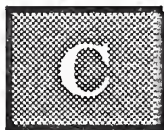
User Survey Questionnaire

A
Computer Applications Directions Questionnaire

1. Please identify which applications you expect your unit to change in the next several years. For each application, please rate its priority on a scale of 5 (High) to 1 (Low), indicate when you expect the changes to occur, and give the reasons/benefits for making the change.

Code	Application Description	Rating	Date	Reasons/Benefits
1a				
1b				
1c				

2. What changes do you expect to make from current computer hardware/software platforms in the next two years? *(Multiple responses permitted.)*

    ☐ Upgrade of existing systems   ☐ Migration to client server platforms
    ☐ Increase in standardization   ☐ Decrease in standardization

    ☐ Other (Describe):_____

3. What vendors have been providing you with computers and services? Please indicate the type of product or service provided and rate your satisfaction with them on a scale of 1 (Low) to 5 (High).

Code	Vendor	Product/Service	Strengths/Weaknesses	Rate
3a				
3b				
3c				

4. What organizational changes do you expect in your area in the next two years, particularly relating to IT (computers and communications)?

    _____

    _____

    _____

5. In your opinion, what are the major issues relative to information systems that you will be addressing in the next two years?

    _____

    _____

    _____

6. How big is your unit (in terms of revenue/employees)?

    _____$ (million)   Number of employees _____

7. In 1994, how much does your organization expect to spend to make applications changes *(give amount or range)*. (Including in-house or consulting staff resources, performing design, testing, installation, software licenses, but *excluding* hardware.)

    ☐ Under $100,000   ☐ $1 - 5 Million
    ☐ $100 - 500 Thousand   ☐ $5 -10 Million
    ☐ $500 Thousand - $1 Million   ☐ Over $10 Million

8. Do you control an Information Systems budget?

    ☐ Yes   ☐ No

    If yes, what % of your organization's annual revenues does this budget represent (approximately)? _____%

9. What will be the rate of change over the next few years for:

    Total IT (Hardware, software, people, networks) spending _____ % Per Year
    Applications   _____ % Per Year

10. Which of the following *best* describes your position?
    ☐ Line manager/executive
    ☐ Staff manager/executive
    ☐ Information systems manager/executive

11. Which of the following, would you say best describes your organization's position in the firm?
    ☐ Corporate department   Department Name: _____
    ☐ Operating division   Division Name: _____

B

Applications Questionnaire

1. For this application, which organization has primary responsibility for the project?
   ☐ User   ☐ Divisional IS User   ☐ Central IS
   ☐ Other (describe):

   _____

2. What resources will be used? (Check all that apply/identify outside vendor)
   A. ☐ User personnel   B. ☐ Divisional IS User   C. ☐ Central IS
   D. ☐ Packaged software   E. ☐ Systems integrator   F. ☐ Outside services
   ☐ Other (describe):

   _____

3. On what computer platform will the application run after implementation? (please identify vendor if known)
   A. ☐ Mainframe   B. ☐ Minicomputer   C. ☐ Client/server/PC LAN
   D. ☐ Hybrid/combination (describe):

   _____

4. Is the application being downsized (i.e. being moved to a smaller or distributed computer system)?

   From: _____   To: _____

   ☐ Yes   ☐ No

5. Is the application being outsourced wither standalone or as part of a larger
    outsourcing plan?
    [...that is, the actual operation of the application after the development and
    implementation.]

    From: _____   To: _____

    ☐ Yes   ☐ No

6. Will the application involve EDI/Network linkage with customers, suppliers, or
    others outside?

    From: _____   To: _____

    ☐ Yes   ☐ No

                                                           DS3

D

Forecast Database

This Appendix explains how the application software forecasts were created.

First, INPUT's 1993-1998 forecast for applications software was analyzed and the percentage of applications that were expected to be installed as C/S applications in 1993 was estimated. Then a growth factor was added, based on a combination of user budget estimates and knowledge of the industry. The figures were then compared with known C/S projects in those industries where applications software specific to an industry were used. This led to the figures adjusted upwards for some industries.

Industries were analyzed depending on the activity undertaken in them. For example, in retailing, point-of-sale applications now use more software, whereas in the past, dumb terminals were connected to mainframes. In telecommunications and cable television there are massive undertakings in C/S technology related to new consumer services. In addition, some analysis was made of how vertical applications are going to be developed.

The object-oriented application frameworks mean that more specialist value-added resellers will market turnkey applications software packages. Companies will be formed by major companies spinning off their IS organizations to form vertical market software companies. Specialist organizations like Visa in banking, Covia in transportation and Bell Communications Research in telephony can be expected to increase the size of the applications software market as they move from custom applications to systems built from standard industry-specific software components. Hence, some of the C/S numbers for 1998 are higher than INPUT's applications software forecasts.

EXHIBIT D-1

Client/Server Applications Software Products Forecast for Vertical Markets

Industry Sectors	Growth Rate 93-94 (%)	1993	1994	1995	1996	1997	1998	CAGR 93-98 (%)
Banking and Finance	121	154	339	390	449	516	594	31
Business Services	135	47	111	141	179	227	289	44
Discrete Manufacturing	60	372	595	951	1,591	1,893	2,252	43
Education	124	111	249	279	313	350	392	29
Federal Government	160	250	650	975	1,073	1,180	1,298	39
Health Services	128	323	737	862	1,008	1,180	1,380	34
Insurance	125	149	335	376	421	471	528	29
Process Manufacturing	80	156	280	420	630	945	1,417	56
Retail Trade	20	200	240	288	346	415	498	20
State & Local Government	20	150	180	216	259	311	373	20
Telecommunications	140	250	600	960	1,536	2,458	3,932	74
Transportation	40	260	364	510	713	927	1,206	36
Utilities	50	150	225	338	506	759	1,063	48
Wholesale Trade	125	163	367	451	554	682	839	39
Misc. Industries	60	100	160	256	410	655	1,049	60
Vertical Industry Total	92	2,835	5,432	7412	9,987	12,970	17,109	43